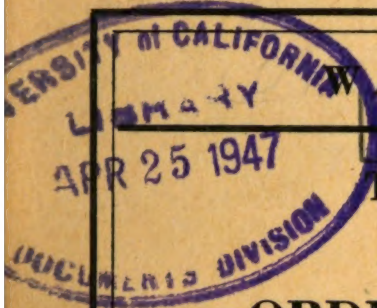


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WAR DEPARTMENT

U.S. Dept. of Army
TECHNICAL MANUAL

ORDNANCE MAINTENANCE
37-MM ANTIAIRCRAFT
GUN MATERIEL

1 APRIL 1943

FOR ORDNANCE PERSONNEL ONLY

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TECHNICAL MANUAL
No. 9-1235

***TM 9-1235**

WAR DEPARTMENT
Washington, 1 April 1943

ORDNANCE MAINTENANCE

37-MM ANTI-AIRCRAFT GUN MATERIEL

Prepared under the direction of the
Chief of Ordnance

(with the cooperation of Pontiac Motor Division, General Motors Corporation)

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*This manual supersedes TM 9-1235, 6 July 1942; TB 1235-2, 1 January 1942; and TB 1235-3, 30 September 1942.

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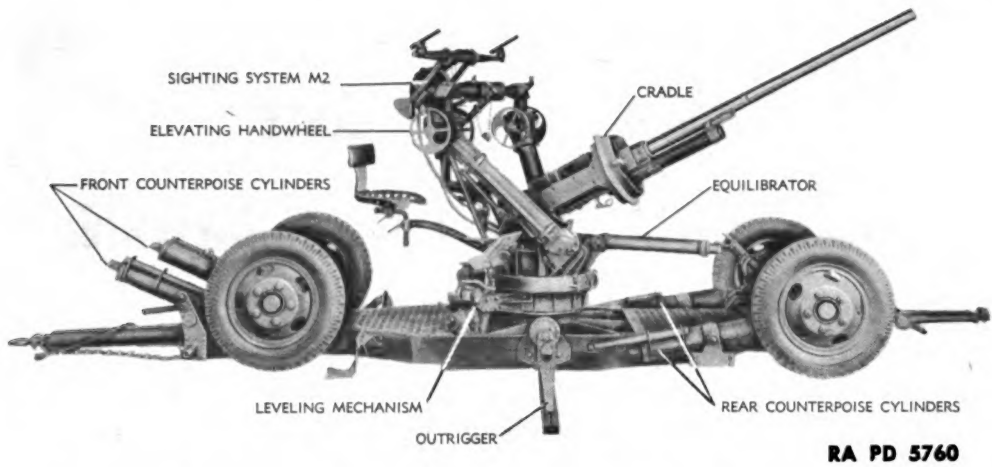


Figure 1—37-mm A.A. Gun Carriage M3—Firing Position



Figure 2—37-mm A.A. Gun Carriage M3E1—Firing Position

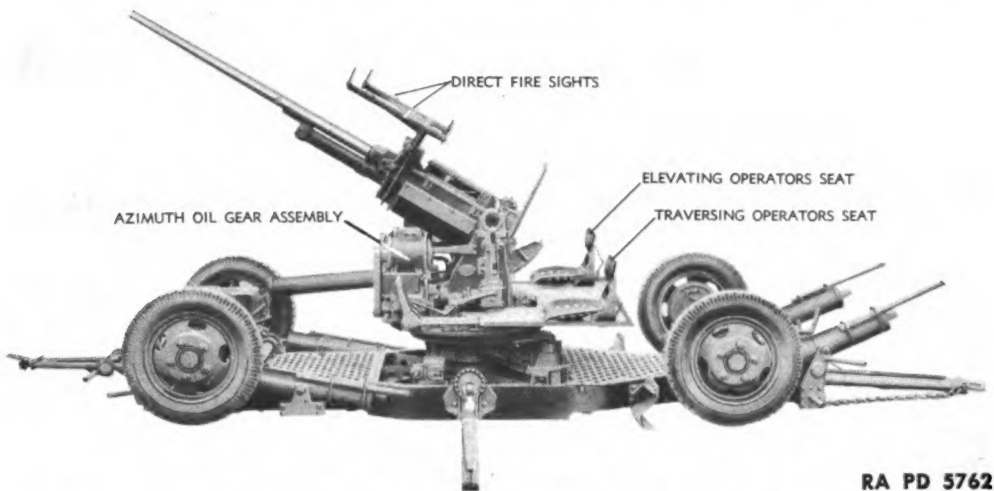


Figure 3—37-mm A.A. Gun Carriage M3A1—Firing Position

Section I

INTRODUCTION

	Paragraph
Scope	1
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Gun data	4

1. SCOPE.

a. This manual is published for the information and guidance of ordnance maintenance personnel. It contains detailed instructions for inspection, disassembly, assembly, maintenance, and repair of the 37-mm Antiaircraft Automatic Gun M1A2 and 37-mm Antiaircraft Gun Carriages M3, M3E1, and M3A1, supplementary to those in the field and Technical Manuals prepared for the using arms. Additional descriptive matter and illustrations are included to aid in providing a complete working knowledge of the materiel.

2. CHARACTERISTICS.

a. The 37-mm Antiaircraft Automatic Gun M1A2 is a high velocity antiaircraft weapon of the long recoil type. The gun can also be fired manually by changing the setting of a foot firing mechanism which is incorporated in the gun carriage. The carriage is a four-wheeled trailer carriage capable of being towed 50 miles per hour over good roads and medium speeds over rough terrain. The carriage is lowered to the ground for firing and raised to the wheels for traveling by means of four counterpoise cylinders. Antitank firing as well as antiaircraft firing is possible for a maximum depression of -5 degrees and a maximum elevation of $+90$ degrees can be realized when gun is elevated manually. A remote-control or "off carriage" system of pointing the gun in firing azimuth and quadrant elevation through data furnished by an M5 Director located approximately 13 feet from the gun (M3A1 Carriage). Power is furnished by a motor-driven generator, also designated as M5.

b. There are three distinct model designations for the carriages mounting the M1A2 Gun, the earliest being the M3, on which the elevating, traversing, and leveling mechanisms are operated by handwheels, while the cradle is of open frame construction. Another distinguishing characteristic is the two M7 Telescopic Sights mounted on the gun. The second model, the M3E1 is similar in appearance to the M3 but includes two water-cooled Browning Machine Guns, cal. .50, M2. Since there are comparatively few of these early units in the field, our text will chiefly concern the third and latest model, M3A1, using double hand cranks for elevating and traversing instead of handwheels, and with the two oil gear units and

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other fire-control equipment mounted on the top carriage, this M3A1 Carriage can be readily identified. A detailed comparison of these models will be found in the following paragraph on carriage data.

3. CARRIAGE DATA.

Item	M3	M3E1	M3A1
Guns	One 37-mm A.A. Automatic Gun M1A2.	One 37-mm A.A. Automatic Gun M1A2 and two water-cooled flexible Browning Machine Guns, cal. .50, M2.	One 37-mm A.A. Automatic Gun M1A2.
Carriage chassis	Four-wheeled towed vehicle type.	Same as M3.	Same as M3.
Brakes	Disk and lever type electric brakes on four wheels. Hand brakes on rear wheels.	Same as M3 Carriage.	Same as M3.
Leveling mechanism	Tilts through a range of 10 degrees. Operated by two hand-wheels.	Same as M3 Carriage.	Tilts through a range of 10 degrees. Operated by two ratchet wrenches secured to the leveling mechanism.
Elevating mechanism	Two speed ratios available for 0- to 85-degree limit elevation. Hand-operated only. One turn of handwheel elevates 3.75 degrees in slow ratio and 11.25 degrees in fast ratio.		One speed ratio. Hand - and power-operated. Mechanical stops at -5 degrees and +90 degrees. Automatic stop switch for power operation at 0 and 85 degrees. One turn of hand crank elevates 4.67 degrees.
Traversing mechanism	Two speed ratios available for 360-degree traverse. Hand-operated only. One turn of handwheel traverses 3.75 degrees in slow ratio and 11.25 degrees in fast ratio.		One speed ratio. Hand - and power-operated for 360-degree traverse. One turn of hand crank traverses 6 degrees.
Equilibrator	Equilibrator connected to cradle by means of a rod.	Same as M3.	Equilibrator connected to cradle by means of a rod and a chain
Firing mechanism	Cam and lever arrangement operated by a foot pedal.	Same as M3 Carriage for the 37-mm gun. Separate pedal for cal. .50 machine guns.	Lever and cable arrangement operated by two foot pedals. Adjustment provided for single or automatic firing.

INTRODUCTION

Item	M3	M3E1	M3A1
Outrigger assembly	Pivots about a bracket centrally located on each side of the chassis. Stands upright for traveling.	Removed from bracket and carried alongside the chassis for traveling.	Same as M3.
Cradle	Open frame construction.	Open frame construction. Contains brackets for attachment of two cal. .50 machine guns.	Frame construction with top, bottom, and front, and rear removable covers.
On-carriage fire-control equipment	Sighting System M2 and Telescopes M7.	Sighting System M2 and Telescopes M7.	Remote - control System M1 and direct fire sights.
Weight, complete, pounds	5,300	5,600	6,100
Rate of fire, rounds per minute	120	120 for 37-mm gun; 650 for cal. .50 machine gun.	120
Over-all length (traveling position), inches	241	241	241
Over-all width (traveling position), inches	69.5	69.5	69.5
Tread, inches	58	58	58
Wheelbase, inches	120	120	120
Height (traveling position), inches	80.5	80.5	72
Height of trunnions above ground, inches	33	33	54.5
Road clearance, inches	11	11	11
Tire size	5.50-18	5.50-18	5.50-18
Tire inflation, pounds per square inch	40	40	40

4. GUN DATA.

a. 37-mm Antiaircraft Automatic Gun M1A2.

Bore, 37-mm	1.457 in.
Weight of gun, complete	365 lb
Length of gun, complete	104 in.
Weight of tube	119 lb
Length of tube	78 in.
Length of bore	53.53 cal.

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Rifling:

Uniform, twist to right, one turn in 30 calibers.

Number of grooves	12
Depth of grooves	0.020
Width of grooves	0.2314
Width of lands	0.150
Number of turns in rifling in tube (approx.)	1.56
Muzzle velocity	2,600 ft per sec
Rate of fire	120 rounds per min
Type of breechblock	Vertical sliding
Recoil mechanism	Hydro-spring
Length of recoil	10 ³ / ₈ to 10 ⁵ / ₈ in.
Recoil fluid	Oil, recoil, light
Recoil fluid capacity	3 ¹ / ₂ pt
Maximum vertical range (H.E. shell)	6,200 yd
Maximum horizontal range (H.E. shell)	8,875 yd
Vertical range, self-destructing (H.E. shell)	3,960 yd
Horizontal range, self-destructing (H.E. shell)	4,070 yd
Weight of high-explosive projectile	1.34 lb
Weight of armor-piercing projectile	1.9 lb
Maximum number of rounds permitted to be fired before cooling:	

Continuous fire	50 to 60 rounds
In bursts within short period	100 rounds
Weight of 1 round, SHELL, H.E., M54	2.62 lb
Weight of 1 round, SHOT, A.P., M59	3.12 lb

b. Water-cooled Flexible Browning Machine Gun, Cal. .50, M2.

Weight of gun with water, 36-in. barrel	110.00 lb
Weight of gun with water, 45-in. barrel	121.50 lb
Weight of gun without water, 36-in. barrel	94.00 lb
Weight of gun without water, 45-in. barrel	100.50 lb
Weight of barrel assembly, 36-in. barrel	14.50 lb
Weight of barrel assembly, 45-in. barrel	17.08 lb
Over-all length of gun, 36-in. barrel	57.00 in.
Over-all length of gun, 45-in. barrel	65.93 in.
Number of grooves in barrel	8
Rate of automatic fire (shots per min)	500 to 650
Ammunition chest, cal. .50, M2, empty	29 lb
Ammunition chest, cal. .50, M2, loaded	89 lb
Links, cal. .50 (200)	8 lb
Cartridges, cal. .50, M1 (200)	52 lb

Section II

INSPECTION INSTRUCTIONS

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5. GENERAL.

a. **Purpose.** Inspection is for the purpose of determining the condition of the materiel, whether repairs or adjustments are required, and the remedies necessary to insure serviceability and proper functioning. Unusual conditions of the gun and carriage noted at inspection will be recorded in the Artillery Gun Book (O.O. Form 5825).

b. **Scope.** The instructions with reference to inspection of the gun and recuperator mechanism are additional to those enumerated in TM 9-235.

c. **References.** For additional instructions regarding inspection, see OFSB 4-1, Maintenance of Materiel in the Hands of Troops, and the first page of the Artillery Gun Book.

6. GUN.

a. Check general appearance for cleanliness. No accumulations of grease, dirt, or grit should be present, and the parts should have neither burrs, scratches, dents, nor any imperfections which might change dimen-

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sions or in any way interfere with their smooth operation. Make certain that all sliding, moving, and pivoting parts operate smoothly and freely.

b. Cotter pins must be spread so that no projecting ends will interfere with the mechanism.

c. Check mounting of gun in cradle. There should be no looseness.

d. Examine for loose or missing parts.

7. GUN TUBE.

a. Check smoothness of screwing the tube into the tube extension and condition of the tube threads.

b. Check condition of bore for copper deposits on the lands and in the grooves. Examine erosion at origin of rifling and wear of firing chamber.

c. Check outer portion of the gun tube for erosion at the point of entry into the trunnion block.

8. BACK PLATE BUFFER.

a. Check for excessive shock during firing. The buffer plunger should not be forced back far enough to strike the rear wall of the buffer cylinder.

9. LOCK FRAME AND DRIVING SPRINGS.

a. Check for smooth operation of driving springs and make certain they have sufficient force to load a cartridge into the firing chamber.

b. Check the operating cams in which the operating lever rides, and examine the action of the two switches that guide the operating lever.

c. Check to see that lock frame moves freely without any signs of grit or burs in its slideways.

10. TUBE EXTENSION ASSEMBLY.

a. Check motion of tube extension by pushing the tube back and forth in the trunnion block after removing the recuperator piston rod nut and driving spring assemblies. The tube extension should move easily with no rubbing or scratching action.

b. Check action of the carrier cam on the carrier, the ejector in the ejector cam, and the feed lever operating stud on the feed lever.

CAUTION: Do not have gun elevated while the recuperator piston rod nut is being unscrewed and the tube extension removed.

11. FEED BOX MECHANISM.

a. Check all links, pawls, and mechanisms in the feed box assembly for burs or scratches that may prevent their smooth action.

INSPECTION INSTRUCTIONS

b. Check spring plungers and springs for cleanliness and free action. All sliding surfaces must be smooth and free from dirt and grit.

c. Check installation of screws securing feed box to trunnion block side plates. The three short screws must all be installed on the right side, or tube extension will not return to battery.

12. FIRING MECHANISM.

a. The gun may fail to fire even though the trigger is pulled back by the foot firing mechanism and the ammunition is in good condition. In this case note whether the tube, tube extension, lock frame, and breech-block are in battery or not. If they are in battery position, then check the functioning of the firing mechanism of the gun. Examine the trigger, trigger bar, trigger levers, trigger trip, sear, firing hammer, and firing pin. These parts should work smoothly with no binding, and should be free from dents and burs. Smooth down such imperfections with CLOTH, crocus, or a fine file and then note their action.

13. FOOT FIRING MECHANISM.

a. Note the action of the foot firing pedal and lock. When the pedal is depressed, the gun fires. When foot pressure is removed from the pedal, the firing mechanism should spring back to its initial position and the pedal should lock. If it does not do this, check the entire mechanism for binding or weak or broken springs.

14. RECUPERATOR.

a. Check recuperator action at high elevation. The recuperator should be capable of returning the tube to battery with no shock. If the gun remains more than $\frac{1}{8}$ inch out of battery, the round will not be fired.

b. Check for any leakage of oil at rear and front end caps.

c. Check the expansion tube by removing it and examining the inside. The tube should be clean, dry, and free from oil.

15. CRADLE.

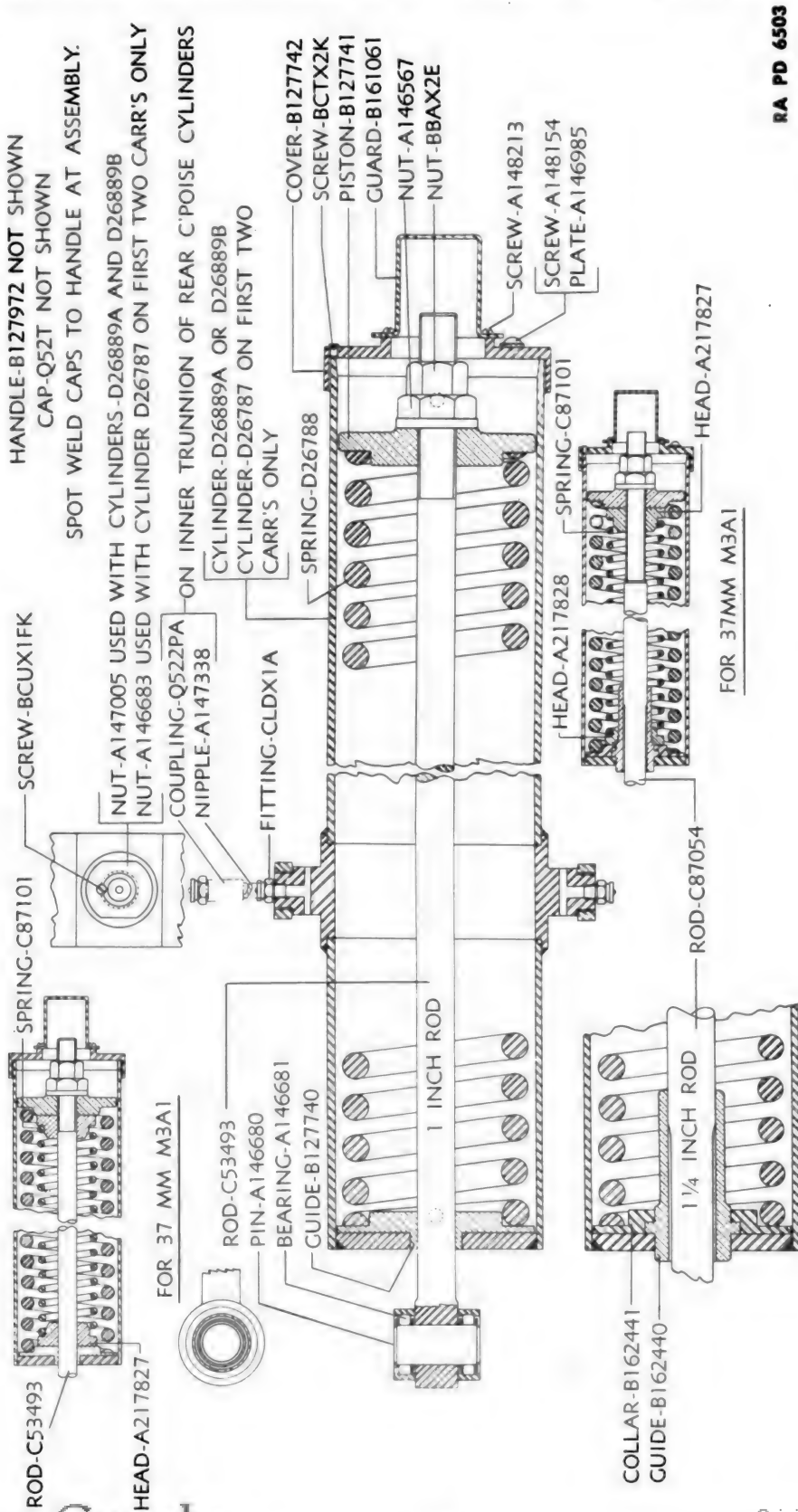
a. Level the carriage with leveling mechanism and place gunner's quadrant on top of cradle. Suspend a plumb line about 20 feet from the gun. Note the degree of error and correct by shimming the trunnions.

b. Check the gun slides of the cradle after removing the gun. These slideways should be straight and smooth, showing no signs of wear or rubbing action caused by a loose fitting of the gun in the cradle.

c. Check condition of the teeth on elevating rack.

d. Check action and assembly of the trunnion bearings by elevating and depressing the cradle. There should be no binding or looseness.

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RA PD 6503

Figure 4—Counterpoise Cylinder Assembly M3, M3E1, and M3A1 Carriages

INSPECTION INSTRUCTIONS

16. CARRIAGE.

a. Check general appearance and examine chassis and firing platform for bent or broken plates, and for cracked welds.

b. Check operation of hinge pin and turnbuckle of outriggers. Examine for bent or broken plates and for cracked welds.

c. **Counterpoise Cylinders** (fig. 4).

(1) Note the action of the carriage as it is let down into firing position and raised to traveling position. The counterpoise springs should allow the carriage to descend to the ground without undue force, and should enable it to be lifted to traveling position by one man at each wheel. If necessary, adjust the springs and test again. If such adjustment cannot be obtained, replace the defective springs.

(2) Counterpoise cylinder wrenches, described in TM 9-235, will be used to adjust the counterpoise springs.

(3) Note the points of attachment of the counterpoise cylinders. These should be well lubricated and should give full support to the counterpoise cylinders as the carriage is raised or lowered.

(4) Check the connection of the counterpoise spring rods to the brackets on the axle arms. There should be neither binding nor undue looseness at these points. Binding may be due to a bent counterpoise rod, bent pin that is pressed into the end of the rod, or defective bearings on ends of the pin.

17. EQUILIBRATOR.

a. Check effort required to elevate and depress gun. Use a hooked spring scale and if effort exceeds 10 pounds, investigate cause. When gun has been stored and equilibrator springs have "set," the effort required to elevate will be greater than that required to depress. If adjustment of equilibrator fails to overcome this condition, replace equilibrator spring or springs.

18. ELEVATING AND TRAVERSING MECHANISMS.

a. Check for binding or excessive backlash. If the handwheel play on M3 or M3E1 Carriage is greater than one-quarter turn on either mechanism, that assembly will have to be disassembled and worn parts replaced as described in paragraphs 40 a and 42 a. On the M3A1 Carriage, there should be *no backlash of any degree*, and any backlash present will necessitate the disassembly of the mechanism, and replacement of worn or damaged parts; or shims should be added in accordance with procedure described in paragraphs 41 and 43.

b. Check for smoothness of operation, by manually traversing top carriage 360 degrees and elevating and depressing gun.

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19. LEVELING MECHANISM.

a. Check operation of both leveling screws through their entire range to note their action. There should be no "catch" or undue binding in this motion.

b. Check level vials for broken or defective tubes and proper level bubble indications, as the top carriage is tilted by means of the leveling screws. If leveling vials do not register accurately when carriage is set in level position on a smooth hard surface and the carriage traversed several complete revolutions while elevating and depressing the gun and cradle, adjustment of the level vials or repair of the leveling mechanism will be necessary. Proceed as described in paragraph 47 e.

20. CARRIAGE BUFFER MECHANISM.

a. Check operation of the buffer mechanism from traveling to firing position and back again. There should be no undue binding of the motion, or of the buffer rods when the carriage is jarred.

b. Check the points on the axle arms where the buffer rod bears against the axle arm. The amount of wear on each of the two front axle arms should be about the same, as should the wear on each of the two rear axle arms. If wear is excessive, axle arms can be built up by welding, in accordance with instructions contained in FSMWO A29-W4.

c. Check buffer levers and buffer lever locks for ease of operation. The locks should secure the buffer lever in either position without the possibility of becoming disengaged. This is important since the accidental disengagement of a lock would cause that section of the carriage to drop and result in injury to personnel or damage to equipment.

21. WHEELS AND TIRES.

a. Check run-out and eccentricity by jacking up axle and spinning wheels by hand.

b. Check wheels, rim flanges, side rings, and valve stems, examining them for bends and damage.

c. Check bearings, by jacking up axle and attempting to shake wheel.

d. Check tire wear, by examining tire tread for side cupping and scuffing. If front tire wear is excessive, check toe-in of front wheels.

e. Check tire pressure. It should be 40 pounds for all wheels.

22. BRAKES.

a. Check dragging of brakes, by jacking up axles and spinning wheels by hand.

b. Check clearance between drums and lining. It should be 0.010 of an inch.

INSPECTION INSTRUCTIONS

c. Check operation, by jacking up axles and spinning wheels by hand. Apply brakes with safety switch. Wheels should stop suddenly when safety switch lever is moved to "ON" position.

d. Check flow of current (amperage) at each wheel in accordance with procedure described in paragraph 54. The lever type brake circuit in good condition will draw 2.2 amperes. The disk type brake circuit in good condition will draw 2.5 amperes.

23. ELECTRICAL SYSTEM.

a. Check lights and blackout light switch by attaching the jumper cable to a prime mover or connect a six-volt battery in the lighting circuit and follow the procedure described in paragraph 54.

b. Check wiring for damaged insulation and insulation deteriorated as a result of oil or grease. Note that all cable clips are in place.

c. Check safety switch by jacking up axle and spinning wheel by hand. Move safety lever to "ON" position and see that it applies the brakes.

d. Check voltage of the dry-cell battery. A new battery will show approximately six volts.

24. WHEEL ALINEMENT.

a. General.

(1) There are many types of equipment used for checking wheel alinement. Regardless of the equipment used, however, the checking and adjusting should be done in a systematic manner and under the proper conditions.

(2) Three basic factors influence front end wheel alinement and all these factors are related and dependent upon each other.

(3) These factors are toe-in, caster, and camber.

(a) Toe-in is the drawing together of the front wheels at the front.

(b) Caster is the backward tilt of the steering knuckle pins at the top.

(c) Camber is the outward tilt of the front wheels at the top.

(4) Since the above factors are interrelated, a general checkup of all factors should be made before attempting to correct front wheel alinement.

b. Inspection Before Checking Alinement.

(1) Inflate tires to 40 pounds.

(2) Check adjustment of front wheel bearings and correct if necessary.

(3) Check for looseness of steering knuckle pins, and if found excessive, they must be replaced before alinement readings will have any value.

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(4) Check for worn and loose tie rods, ball studs, and steering rod joint pins, replacing parts if worn.

c. Wheel Bearing Adjustment.

(1) Jack up wheel and place support under chassis.

(2) Eliminate the play of the steering knuckle pin by inserting a wood block between steering knuckle and axle arm.

(3) Tighten bearing adjusting nut enough to insure that parts are properly seated. Back off the nut until the first perceptible looseness is felt in the bearings. This can be tested by grasping the tire at top and bottom and shaking the wheel. Then tighten until a slot in the nut lines up with hole in the knuckle and install the cotter pin. Remove wooden wedge.

d. Looseness of Steering Knuckle Pin.

(1) After adjusting front wheel bearings, and with tire off the ground, check steering knuckle pin for looseness. Grasp the tire at top and bottom; alternately push and pull while observing movement taking place between steering knuckle and pin.

(2) If the top of the tire can be moved in and out $\frac{1}{8}$ inch or more, the steering knuckle bushings, and steering knuckle pin should be replaced.

e. Tie Rods.

(1) Tie rods are of the self-adjusting type on the ball end. A spherical seat is provided in the outer end of the tie rod, for the tie rod ball. Another spherical seat bears against the tie rod ball and is held firmly against the ball with a coil spring and ball seat plug.

(2) The tie rod is not adjustable for purposes of adjusting toe-in. When severe wear has taken place, it must be replaced. In an emergency, or when an accident has caused distortion of the tie rods sufficiently to cause tire wear in moving the carriage, the tie rods may be straightened to secure proper toe-in of front wheels.

f. Toe-in of Front Wheels.

(1) Proper toe-in of front wheels is most important as too little toe-in or toe-out of front wheels will cause rapid tire wear.

(2) The total toe-in of front wheels should be $\frac{1}{8}$ inch, divided evenly between the right and left wheel.

(3) To check toe-in, use any approved tool available similar to the one shown in figure 5, the use of which is described below.

(a) Place the carriage on a level surface and move it straight ahead for a short distance to make sure that the drawbar is in a direct line with the center of the carriage.

(b) Place the wheel aliner between the front wheels in a horizontal position leveling both ends with spirit levels. Press the aliner as far as

INSPECTION INSTRUCTIONS

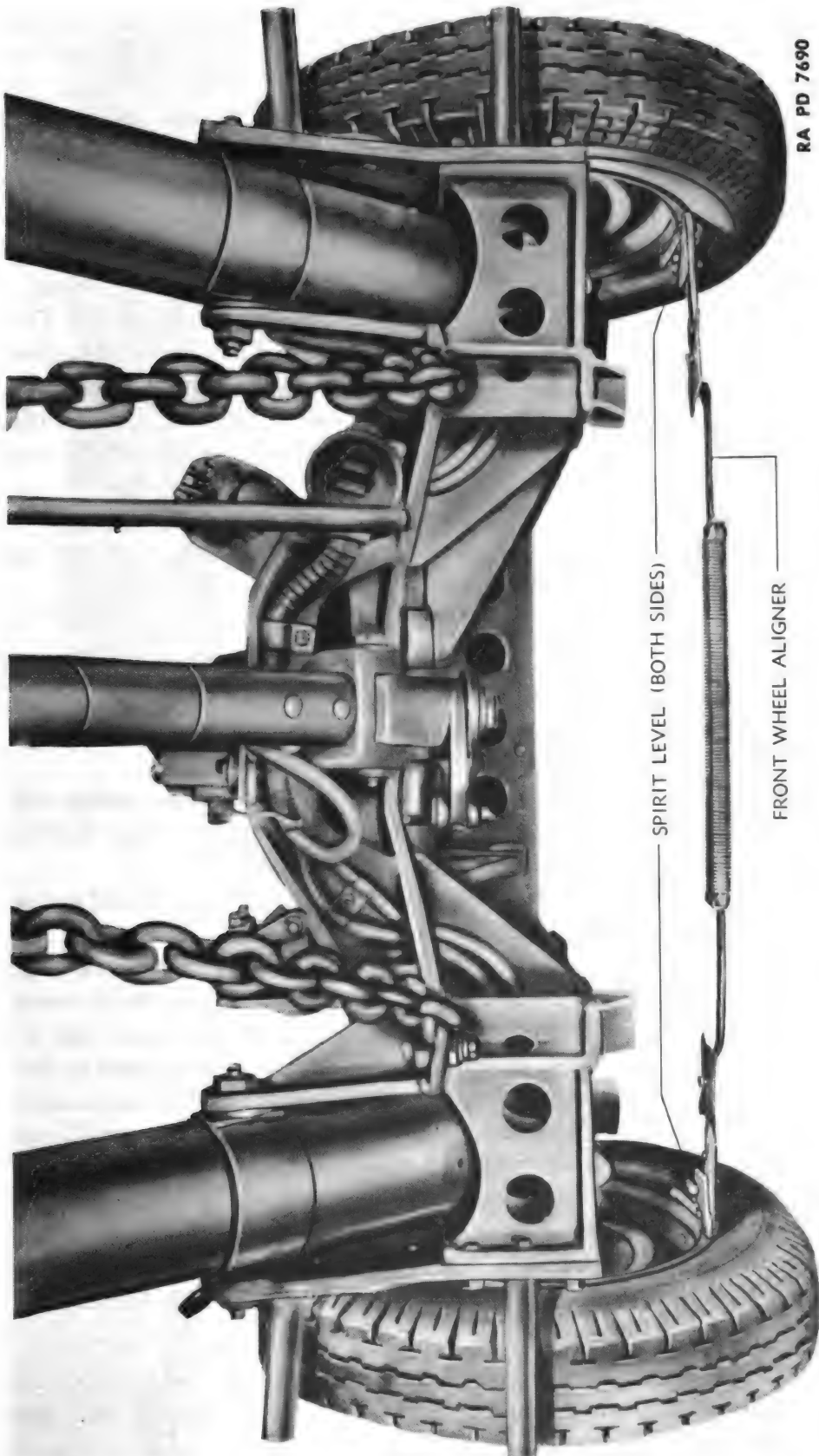


Figure 5—Checking Front Wheel Toe-in

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possible into the curvature of the wheels. Turn the wheels until one dial registers "ZERO." Press the front wheels apart at the front to take out the slack, keeping the pointer on one dial at "ZERO." The other dial will then register the combined toe-in of the two front wheels in inches.

(c) Move the carriage forward so that wheels make one-third revolution and take another reading. Then move forward another one-third wheel revolution and take another reading. The average of the three readings is the toe-in or toe-out.

(d) Have the drawbar in direct line with center of chassis. Hold a chalk line across beads of front and rear tires on one side of carriage. The chalk line should be held so that it is against beads of rear tire and against the bead at rear of front tire. Observe if space between chalk line and bead of front tire at the front is approximately $\frac{1}{16}$ inch or one-half the total toe-in of front wheels. Repeat the operation on right side of carriage; this will determine if each wheel has the proper toe-in.

(e) Do not determine on replacement of tie rods for correction of toe-in until caster and camber have been checked, for the cause of incorrect toe-in may also be a bent steering knuckle or steering arm.

g. Checking Caster.

(1) The caster or backward tilt of the steering knuckle pin at the top, may be checked with a caster gage. Specifications indicate a 0-degree of caster, but tolerances of related steering and suspension could cause the gage to show caster up to two degrees.

(2) Before checking caster, make sure that counterpoise springs are properly adjusted and that buffer assemblies are in good order so that lower end of buffer rod just touches the front axle arm.

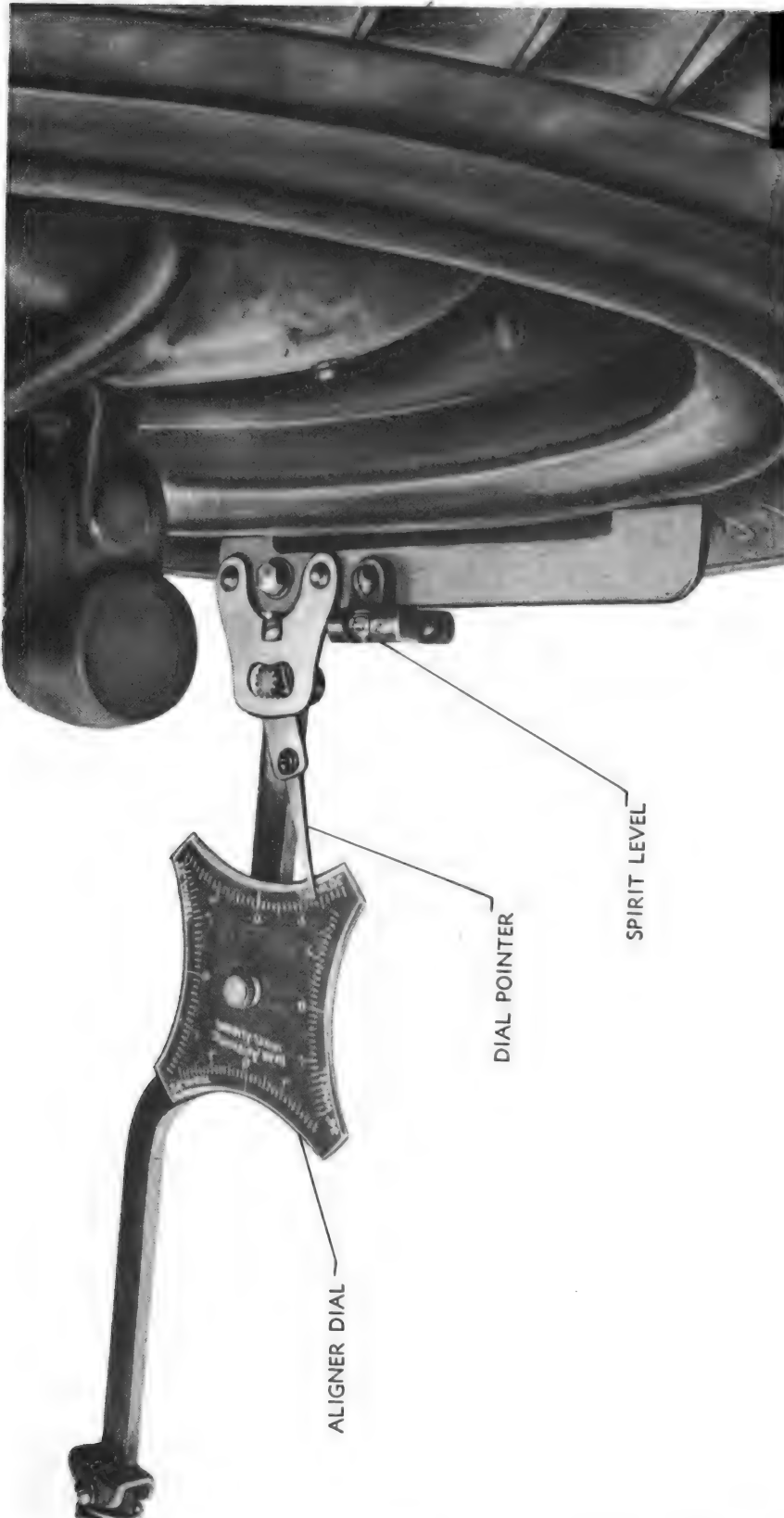
(3) If possible, place front wheels on turntable and place board under rear wheels so that wheels are on the same plane.

(4) Set the wheels in straightforward position. Remove the hub caps from the front wheels and place the caster gage against the wheel, being sure that the gage is level according to the spirit level. Adjust the gage so that its left spring plunger seats into the lathe center at the end of the wheel spindle. Swing the wheel spindle around so that right spring plunger will seat into the same lathe center. To do this, the right plunger will have to be adjusted, due to the caster angle, thus causing the scale pointer to indicate the caster angle to degrees. The fact that the front wheels are jacked up must be taken into consideration when reading the caster angle. Deduct three-quarters of a degree from the reading on the gage to obtain the actual caster angle. Replace bent parts if caster is incorrect.

h. Checking Camber.

(1) The camber, or outward tilt of the front wheels at the top, may be checked with an instrument similar to the one shown in figure 165, the use of which is described below:

INSPECTION INSTRUCTIONS



RA PD 7691

Figure 6—Scale Reading, Showing 1 $\frac{3}{8}$ Inches Exaggerated Toe-in

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RA PD 7692

Figure 7—Scale Reading, Showing 1 1/4 Inches Exaggerated Toe-out

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(a) Set the front wheels in straightforward position, with the draw-bar in a direct line with the center of the carriage. Place the wheel aliner between the front wheels in a vertical position. Check with a spirit level and make sure the abutment bars are both perfectly level. Care must be taken to force the aliner as far as possible into the curvature of the wheel. Dial readings may now be taken at each wheel. The older type aliner will give dial readings in inches only. The newer type aliner gives readings in inches and degrees, showing the pitch of each wheel. The dials on both types are graduated to accommodate various wheel diameter sizes. Use the dials which most nearly correspond to the wheel diameter.

(b) An average of two readings should be taken, the second reading to be made after rotating wheels one-half turn to compensate for run-out of wheel which may be due to bent rims.

(c) If camber is less than two degrees, check for worn steering knuckle pin, steering knuckle bushings or bent steering knuckle. There is no adjustment for camber as it is a built-in feature of the axle, and replacement of parts causing incorrect camber is the only correction.

i. Replacement of Front Axle Parts.

(1) By means of a visual check for looseness in worn parts, and by comparing results of toe-in, caster, and camber readings, the parts that offset incorrect alinement can be determined and replacement made accordingly.

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Section III

MAINTENANCE AND REPAIR INSTRUCTIONS

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25. GENERAL.

a. A list of malfunctions, causes, and their corrections is included in TM 9-235. In addition, ordnance maintenance personnel are responsible for maintaining the rest of the material in proper working condition.

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b. Second echelon operations described in TM 9-235 are sometimes performed by ordnance maintenance personnel, who should refer to that manual for information.

c. Illustrations of the tools required for maintenance and repair operations are embodied in the text of this section, adjacent to descriptions of disassembly and assembly procedures which require their use.

d. When practicable, simple wooden supports can be made to support gun assembly while removed from carriage.

26. MAINTENANCE SUGGESTIONS.

CAUTION: Do not use gasoline or kerosene for general cleaning purposes. Use only SOLVENT, dry-cleaning. Do not use high-pressure air or water hose for cleaning purposes.

a. **Cotter Pins.** Always use new cotter pins, when assembling the various subassemblies of the gun and carriage mechanism.

b. **Used Parts.** In the absence of detailed specifications, used parts may be checked to determine if they are fit for further use, by comparing them with new parts of the same design.

c. **Bent Parts (Heat-treated).** Practically all working parts of the gun and carriage have been heat-treated to provide the inherent characteristics required by their individual use. Should such parts become bent, they should be replaced. Heating parts of this type, for straightening and correcting other irregularities, will render them unfit for further use as it practically destroys the original heat treatment given them in process of manufacture.

d. **Ball and Roller Bearings.** Clean ball and roller bearings by flushing with SOLVENT, dry-cleaning, only. When clean, lubricate and wrap in clean paper until used. Do not lay bearings down on a dirty bench or floor; place them on a clean paper. Ball and roller bearings should never be forced on a shaft by driving against the outer race. Neither should they be driven in a housing by driving against the inner race. Wherever possible, antifriction bearings should be forced into position in an arbor press. In any event, care should be taken to start the bearing straight so as not to damage the shaft or housing. A light film of oil on the shaft or in the housing bore will make the mounting of the bearing easier.

e. **Antifriction Bearings.** If an antifriction bearing is to be forced over a long shaft or a tight fitting seat in order to reach its location, it may be desirable to expand the bearing slightly by heating it in oil. When a bearing is heated in oil, the temperature of the oil should not exceed

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200 F and the bearing should be removed from the hot oil as soon as the desired expansion has been obtained, as there is danger of drawing the temper of the balls and races if the bearing is immersed too long or the oil temperature is too high.

f. Oilite Bushings. Extreme care must be taken in installing Oilite bushings. They should never be forced into position by blows applied directly over the wall thickness of the cylindrical type or over the flange of the flange type. Wherever possible, Oilite bushings should be forced into position in an arbor press. The desired bushing clearance to obtain best shaft fitting should never exceed 0.001 inch to 0.0015 inch. The bushing should be started straight and pressed evenly into the bore. A light film of oil, applied in the receiving bore or to the outside of the bushing, will make mounting of the bushing somewhat easier. Scraping, burnishing and reaming of undersized Oilite bushings is not recommended. The approved method of sizing an Oilite bushing is to force a hardened steel ball of the correct diameter through it by means of an arbor press.

g. Determining Right and Left Side. The sides of the chassis part of the gun carriage are generally referred to herein as right and left when viewed from the rear looking forward toward the drawbar assembly. Similarly, the sides of the gun and upper carriage assembly (traversing member) are considered as right and left when viewed from the rear end of the breech casing looking forward toward the barrel.

27. WELDING ROD RECOMMENDATIONS.

a. All welded assemblies, mild steel, or alloyed steel may be welded with an all-purpose rod such as Lincoln, Fleetweld No. 5 or Shieldarc No. 85. This rod may be used for welding in all positions.

b. All parts of the carriage may be welded with the exception of gears, shafts, and spindles. Gear cases and housings may be brazed.

28. GUN DISASSEMBLY AND ASSEMBLY BY GROUPS.

a. The following sequence of disassembly and assembly may be used as a guide when a complete disassembly of the 37-mm M1A2 Gun is desired, or it may be used as a reference before attempting removal of any component group or assembly.

b. Order of Disassembly.

(1) Unhook left and right driving spring assemblies with lock frame in battery position and disconnect driving spring tube connection from the tube extension assembly. Remove the following assemblies in order:

(a) Back plate assembly.

(b) Accelerator cam assembly.

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- (c) Lock frame assembly.
- (d) Driving spring assemblies.
- (e) Gun tube.
- (f) Feed box mechanism.
- (g) Tube extension.
- (h) Trigger bar.
- (i) Back plate latch assembly.
- (j) Rear and front operating cam assemblies.
- (k) Recuperator piston rod and spring assembly.

c. Order of Assembly.

- (1) Install the following assemblies in order:
 - (a) Recuperator piston rod and spring assembly.
 - (b) Front and rear operating cam assemblies.
 - (c) Back plate latch assembly.
 - (d) Trigger bar.
 - (e) Tube extension.
 - (f) Feed box mechanism.
 - (g) Gun tube.
 - (h) Driving spring assemblies.
 - (i) Lock frame assembly.
 - (j) Accelerator cam assembly.
 - (k) Back plate assembly.
- (l) Connect left and right driving spring assemblies to lock frame and tube extension.

29. DRIVING SPRING ASSEMBLIES.

a. Removal.

- (1) Disconnect left and right driving spring assemblies; then remove lock frame.
- (2) Disconnect driving spring tube connection from the driving spring front bracket by pulling rearward on the connection pin knob, turning the connection outward, and removing driving spring assembly from the gun.

b. Disassembly.

- (1) Unscrew driving spring tube connection pin knob by first removing lock pin A25459, thus releasing connection pin A25458 and spring A25467.
- (2) Remove cotter pin and pin A25456 from driving spring rod connection B163251, thus releasing the safety, rod hook, plunger, and spring.
- (3) Unscrew driving spring tube bushing A25460 from rear end of driving spring housing assembly. The edges of the housing are staked into slots in the bushing; pry free, using blade of screwdriver.

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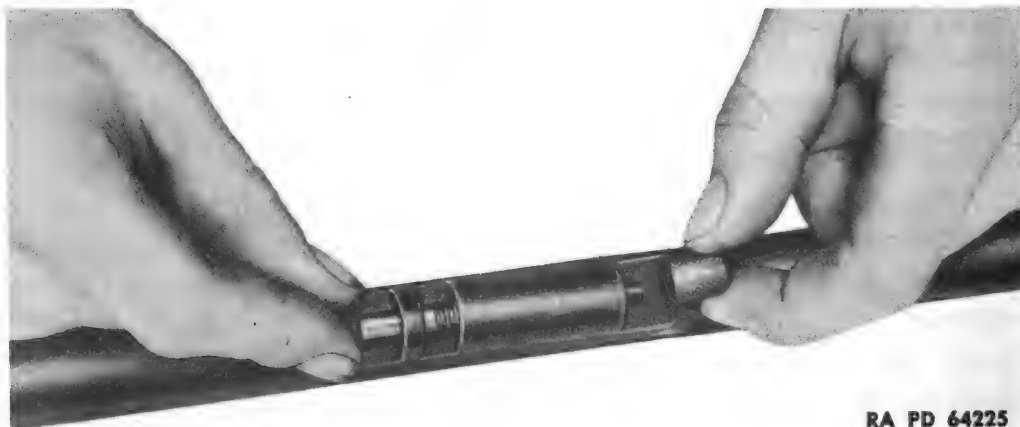
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Figure 8—Disconnecting Driving Spring Tube

CAUTION: Do not under any circumstances use a vise to hold driving spring housing while disassembling. The slightest pressure will kink the tube and prevent the free movement of the driving spring rod assembly. Insert the blade of screwdriver in slot of driving spring tube bushing and turn tube clockwise to remove.

(4) Withdraw driving spring rod assembly from housing.

(5) Remove cotter pin from rod connection B163251 and remove connection from rod. This will release the driving springs A25465, spacer A25464, and driving spring bushing A25460.



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Figure 9—Removing Driving Spring Tube Connection Pin Knob

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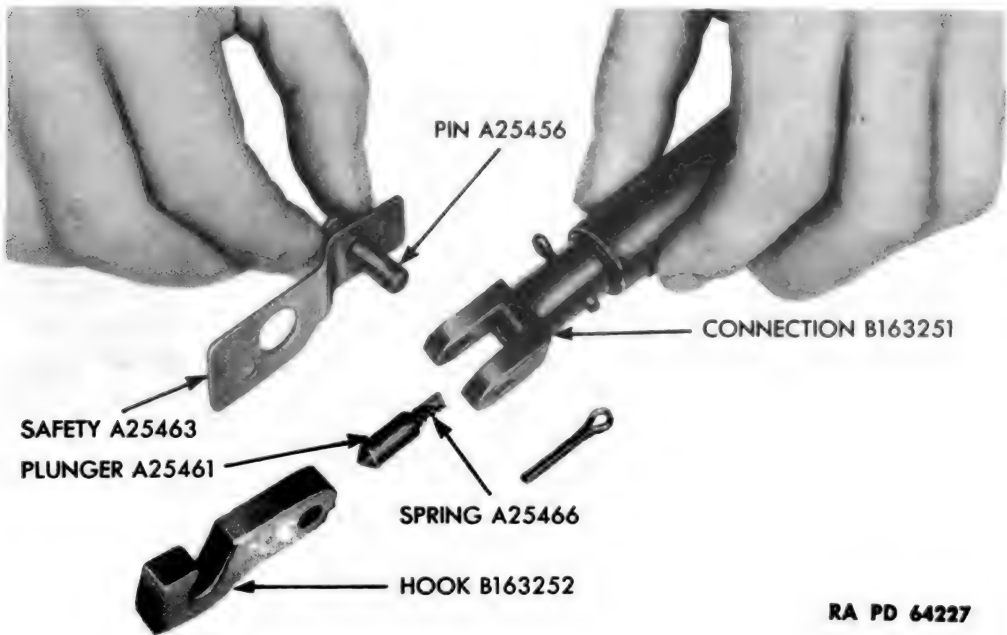


Figure 10—Removing Safety, Rod Hook, Plunger and Spring

NOTE: These connections and rods are not interchangeable, so place all connections back on the same rods to avoid interchanging these parts.

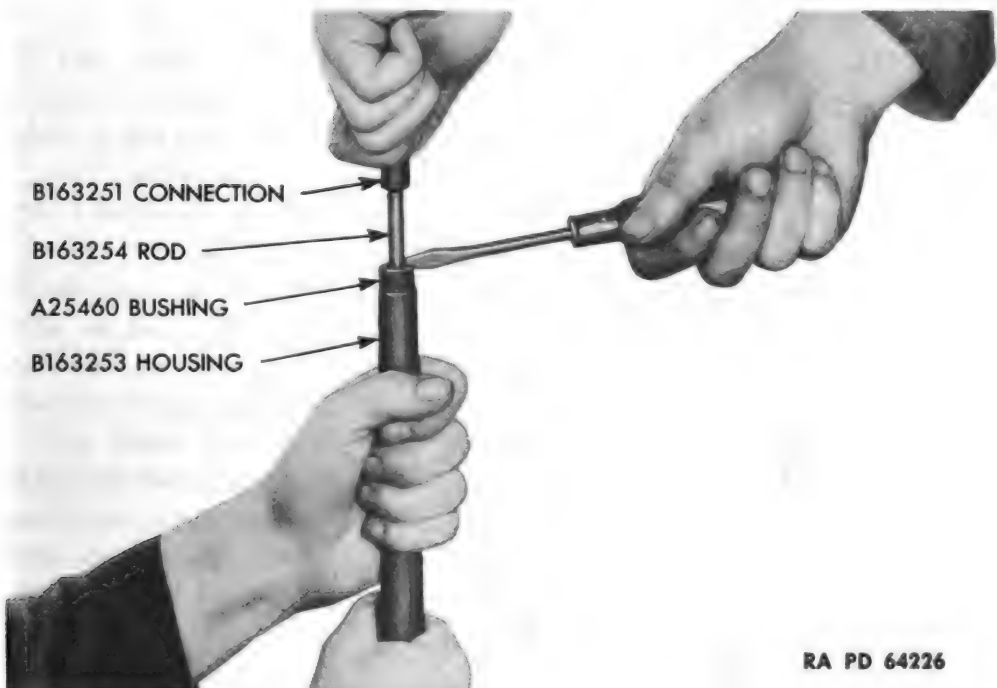
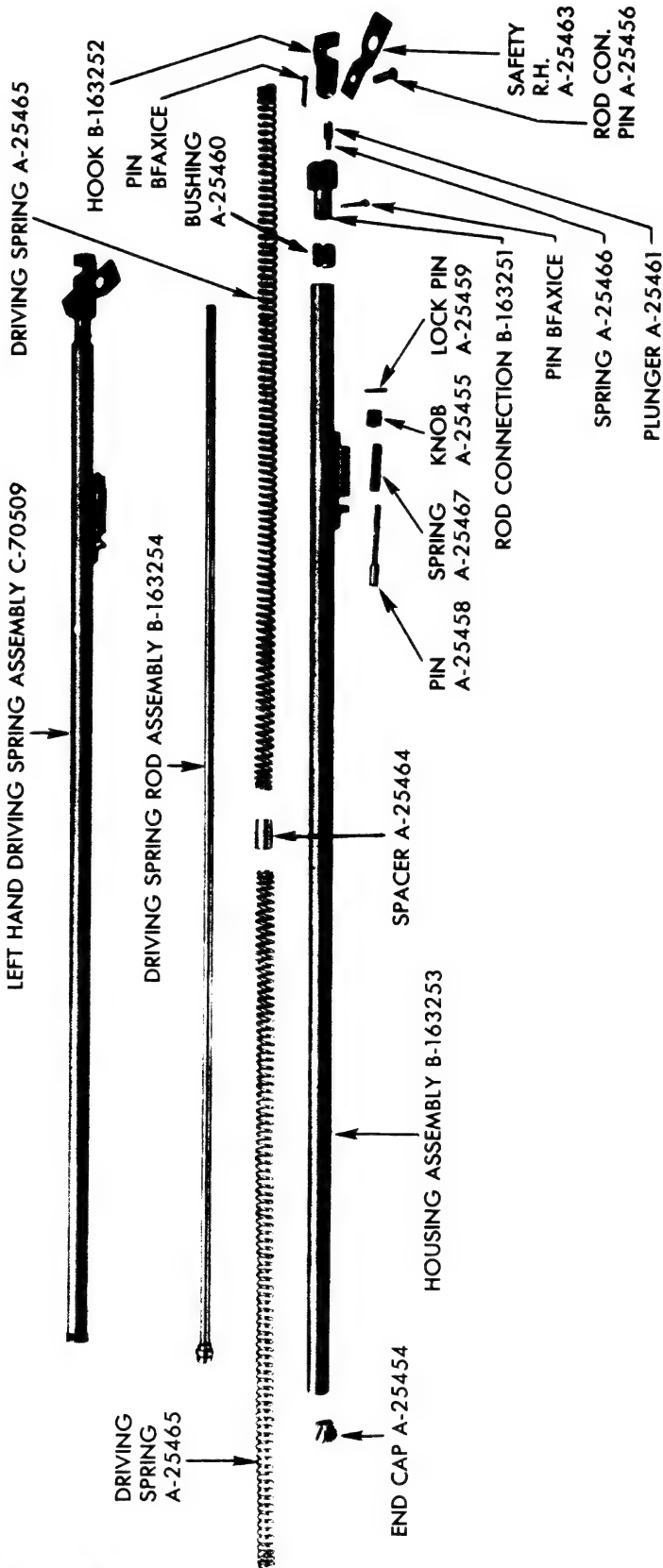


Figure 11—Unscrewing Driving Spring Tube Bushing

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Figure 12—Driving Spring Assembly (Exploded View)

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(6) Unscrew driving spring tube end cap A25454. Edges of housing are staked into recess under head of end cap. Extra effort on screwdriver will remove staking.

(7) Piston is not to be removed from rod.

c. Inspection.

(1) Check free length of driving springs. A new spring measures between 22 and 23 inches. Replace a weakened or "set" spring.

(2) Clean driving spring assemblies thoroughly with SOLVENT, dry-cleaning, making certain to remove all gummy or heavy lubricant.

(3) After cleaning, flush with OIL, engine, SAE 10.

(4) Make certain the small hole in forward end of cover is open.

(5) Inspect all camways and slideways for freedom from dirt, burs, or rough surfaces.

(6) Replace driving spring tube body A25449, if bent or dented.

d. Assembly.

(1) Screw driving spring tube cap A25454 into front end of tube, making certain the vent hole is clear, and restake end of housing into recess.

(2) Remove connection from rod; then slide driving spring A25465, spacer A25464, driving spring A25465, and bushing A25460, on driving spring rod assembly, in the order named. Place the small end of springs towards the bronze spacer.

(3) Compress springs manually and install rod connection B163251 on rod, screwing up until cotter pin holes are alined. Install $\frac{3}{32}$ - by $\frac{3}{4}$ -inch cotter pin BFA11CE from opposite side to the hole for the connection pin cotter pin.

(4) Install spring and rod assemblies in housing and screw bushing down flush with end of tube. Stake edges of tube into the slots in bushing.

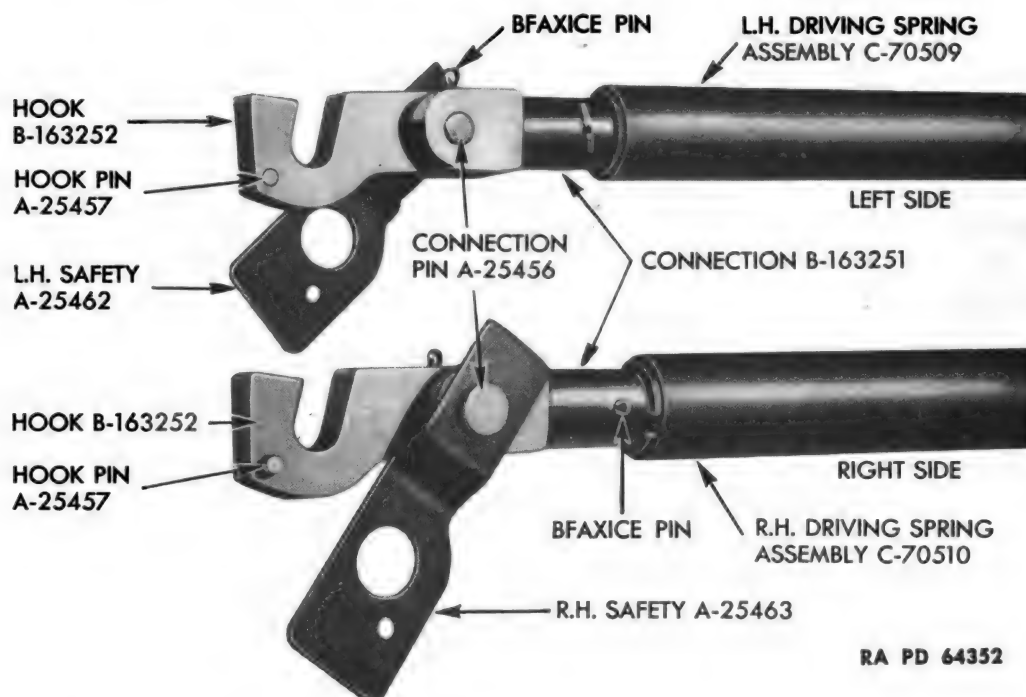
(5) Place hookspring A25466 and plunger A25461 in rod connection. Place hook in the connection, with driving spring rod hook pin on same side as head of cotter pin in connection. Install rod connection pin A25456 and safety A25463 on the same side and secure with $\frac{3}{32}$ - by $\frac{3}{4}$ -inch cotter pin BFA11CE with head up.

(6) Place spring A25467 on driving spring tube connection pin A25458; then install pin and spring in tube connection. Compress spring and screw knob A25455 on the pin until hole for lock pin is visible. Insert tube connection pin lock pin A25459, bending ends around connection pin. Back off knob until it is tight against lock pin.

e. Installation.

(1) Slide driving spring assemblies into the bearings in the tube guards from the rear.

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RA PD 64352

Figure 13—Correct Assembly of Hook, Safety, and Cotter Pins

NOTE: Driving spring assemblies are not interchangeable, because of the driving spring rod hook and hook safety, left and right.

(2) Connect each spring assembly to the driving spring front bracket (on tube extension) by pulling rearward on the tube connection pin knob while engaging notch in tube connection with end of bracket.

(3) Install lock frame assembly.

(4) Turn hooks of driving spring assemblies to point upward and engage with rear bracket of lock frame. If spring assemblies are correctly in place, the safety will be on the outside of each hook. Swing hook safety up into position to lock hook in position.

30. TRUNNION BLOCK SUBASSEMBLIES.

a. The following units are attached to the trunnion block and can be removed or installed after removal of the tube, back plate, lock frame, and tube extension assemblies, should a complete disassembly be required, or a unit replacement be necessary.

b. Tube Lock Depressor Assembly.

(1) **REMOVAL.** Remove tube lock depressor B163274, spring A25512, and body B163273 which are secured to the top flange of the left side plate by removing one long A25510 and two short A25511 fillister-head screws.

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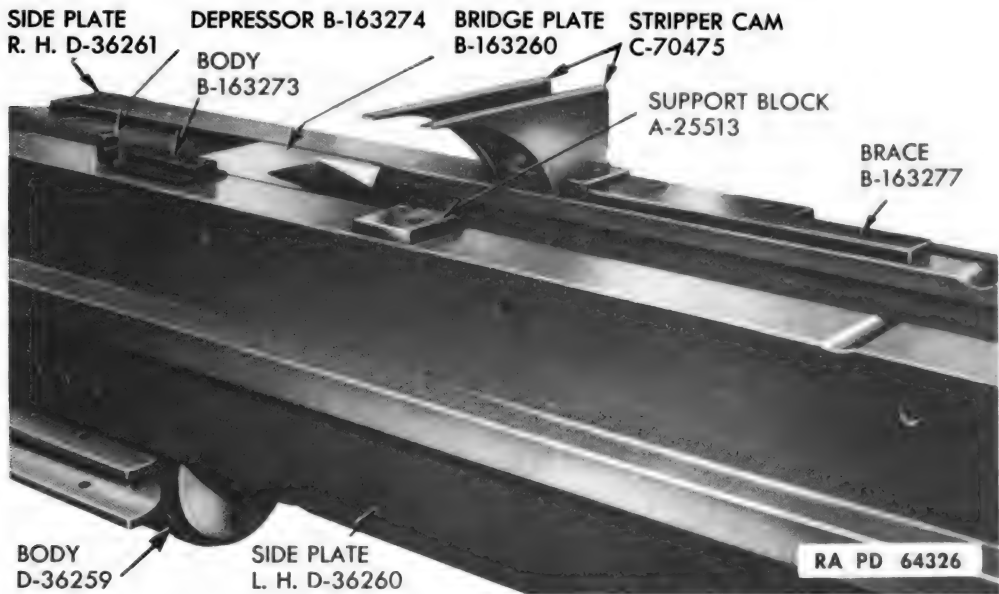


Figure 14—Trunnion Block Subassemblies

(2) **INSTALLATION.** Place tube lock depressor spring A25512 in body B163273 and fasten body to left top flange of trunnion block side plate with the three fillister-head screws.

NOTE: The long screw A25510 is installed in the rear hole.

c. Cartridge Support Block.

(1) **REMOVAL.** Remove the two screws A25514 securing cartridge support block A25513 to trunnion block, and remove.

(2) **INSTALLATION.** Place cartridge support block on top flange of left side plate of trunnion block and install the two retaining screws.

d. Stripper Cam.

(1) **REMOVAL.** Remove the three screws A25507 securing stripper cam C70475 to trunnion block and remove cam.

(2) **INSTALLATION.** Place the stripper cam on top flange of right side plate of trunnion block and install the three retaining screws. Secure screws firmly.

e. Carrier Bearing Brace.

(1) **REMOVAL.** Remove the two screws A25514 securing the carrier bearing brace B163277 to trunnion block and remove brace.

(2) **INSTALLATION.** Place carrier bearing brace on top flange of right side plate of trunnion block and install the two retaining screws firmly.

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**Figure 15—Removing Switch****f. Top Plate.**

(1) **REMOVAL.** Remove the four screws A25404 securing top plate to side plates of trunnion block and remove the plate C70476.

(2) **INSTALLATION.** Place the top plate in position and install the four retaining screws.

NOTE: If screws do not start easily, align holes by pressing inward on side plates. This is important for threads on either screws or side plates will strip if forced. Do not tighten screws until back plate assembly has been installed.

g. Front and Rear Operating Cams.**(1) REMOVAL.**

(a) Turn gun over.

(b) Remove both rear operating cam assemblies C70473 and C70474 which are secured to the side plate bottom flanges by four screws A25507 in each cam.

(c) Remove the switch B163279 from switch pivot A25518 in each side plate by depressing the switch spring plungers; then remove plungers A25519 and springs A25520.

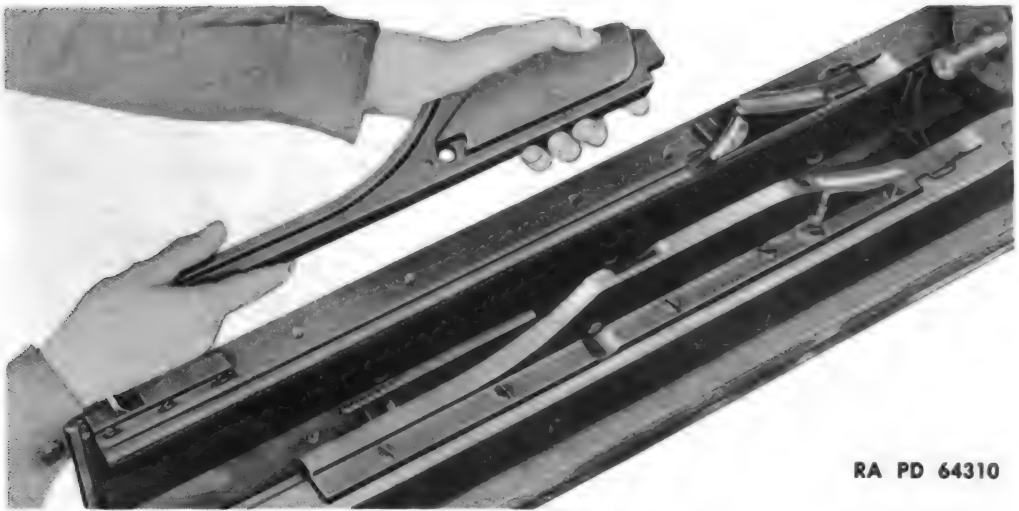
(d) Remove both front operating cam assemblies C70471 and C70472 by removing two screws A25507 in each cam.

(2) INSTALLATION.

(a) Install both front operating cam assemblies on their respective side plates, with two screws in each. Start all screws; then tighten them evenly.

(b) Install switch spring A25520, plunger A25519, and switch B163279 in each rear cam. Install both rear cam assemblies on their

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Figure 16—Removing Rear Operating Cam

respective side plates, with four screws in each. Start all screws; then tighten them evenly.

h. Back Plate Latch Assembly.

(1) **REMOVAL.** Remove the six screws T25508 securing back plate latch to bottom flange of trunnion block side plate. Be careful not to lose the back plate latch spring A25509. Lift off back plate latch assembly.

NOTE: Gun should be in inverted position.



RA PD 64305

Figure 17—Removing Back Plate Latch Assembly

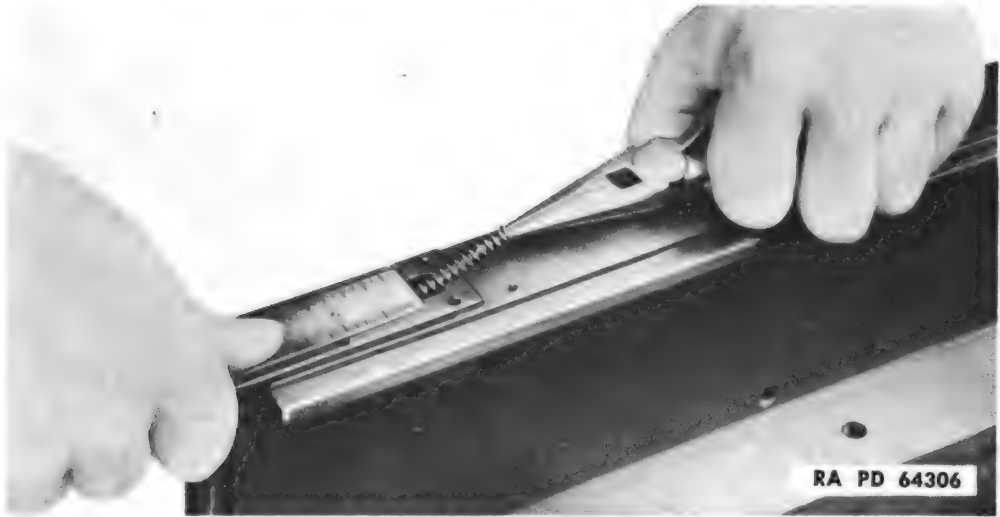


Figure 18—Assembling Back Plate Latch Spring

(2) INSTALLATION.

(a) Turn back plate latch body B163271 upside down on bottom flange of side plate and install back plate latch slide B163272 in body; then start back plate latch spring A25509 in body assembly and guide with a steel scale or similar object.

(b) Force spring into body with a pointed object, similar to the needle nosed pliers pictured. Slide steel scale over spring to keep it in place.

(c) Turn scale and back plate latch assembly over and place it in position. Carefully remove scale and install the six retaining screws A25508.

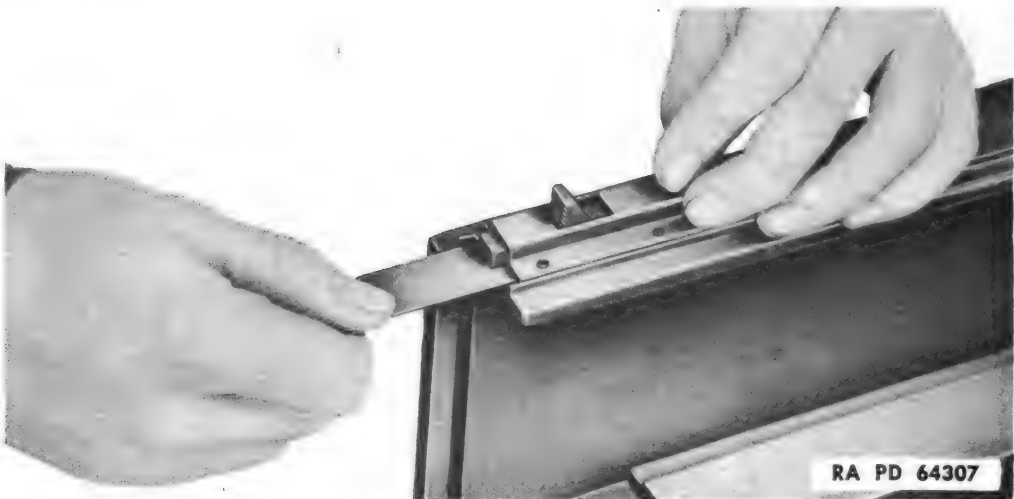


Figure 19—Installing Back Plate Latch Assembly

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Figure 20—Removing Recuperator Filler Screw

31. RECUPERATOR AND RECUPERATOR PISTON ROD AND SPRING ASSEMBLY.

a. Removal.

NOTE: Make sure gun is in upside-down position. Tube, lock frame, tube extension, and front and rear operating cam assemblies must be



RA PD 64327

Figure 21—Removing Recuperator Front End Cap



Figure 22—Removing Recuperator Rear End Cap

removed before recuperator or recuperator spring assemblies can be removed.

(1) Remove filler screw A25535 and expansion tube relief screw A25533, and drain oil from recuperator.

(2) Use wrench B163290 and unscrew front end cap B163280. Have drain pan underneath to catch oil remaining in recuperator.



Figure 23—Removing Recuperator Spring Assembly

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Figure 24—Releasing Recuperator Bushing Lock

(3) Unscrew rear end cap B163281 which is part of recuperator spring assembly.

(4) Install a suitable guard of sheet metal or heavy cardboard over the trunnion block side plate flanges to protect them from marring when recuperator spring assembly is removed.

(5) Remove recuperator spring assembly from recuperator by pulling rearward on rear end cap. Guide the spring during removal so that it will



Figure 25—Removing Recuperator Bushing

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not contact and damage the threads in rear opening of recuperator.

(6) Depress recuperator bushing lock B163282 with screwdriver, and remove recuperator bushing C70478.

NOTE: The following operations described in steps (7), (8), (9), and (10) below, need not be done when servicing the gun unless the parts are damaged and require replacement.

(7) Remove recuperator expansion tube B163286 by unscrewing it counterclockwise out of the expansion tube socket.

(8) Remove driving spring tube guards.

(a) Remove driving spring tube guard front yoke B163269 by removing four screws A25536.

(b) Remove four screws A25537 which secure the guards C70479 and C70490 to the driving spring tube guard rear yoke B163270, and remove the guards.

(c) Remove two screws A25537 which secure rear yoke to trunnion block.

(9) Remove recuperator expansion tube socket D36266 by heating evenly with a torch to soften the solder around the three screws A25534 and between the socket and the recuperator. Then remove the three screws and tap the socket loose from the recuperator.

(10) Remove the recuperator D36265 from the trunnion block body D36259 by unscrewing it in a counterclockwise direction, with a suitable clamp.

b. Disassembly.

(1) Place flat surfaces on rear end of recuperator piston rod securely in a vise. Remove cotter pin from piston and rod.

(2) To release spring pressure on the piston, a clamp should be used, so constructed that it clamps around the recuperator spring just below the piston. The one used in the following illustration consists of two pieces of wood bolted together so as to grip the spring.

(3) While two men relieve the spring pressure by pressing down on the handles of the clamp, a third man removes the recuperator piston assembly A25538.

CAUTION: A spring pressure of 365 pounds can be expected; therefore spring should be kept under control and tension gradually released.

(4) Remove the two recuperator recoil springs B163285 and the separator B163284 from piston rod B163283.

(5) Remove the two screws A25525 from the stuffing box spring holder. These screws are staked in the end cap.

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Figure 26—Disassembling Recuperator Spring Assembly

(6) Remove stuffing box spring holder A25523, spring A25526, gland A25522, packing A25524, and rear end cap B163283.

c. Inspection.

- (1) Clean all parts free of oil and dirt.
- (2) Inspect recuperator piston assembly and recuperator bushing for excessive wear and scoring. Replace, if worn excessively or scored.
- (3) Inspect the shoulder on recuperator and the front end of trunnion block body to make sure they are clean and free of burs.
- (4) Inspect recuperator recoil springs and check for "set." The free length of each spring should be between $17\frac{3}{4}$ and $18\frac{3}{4}$ inches.
- (5) Clean and inspect all threads for burs or roughness.

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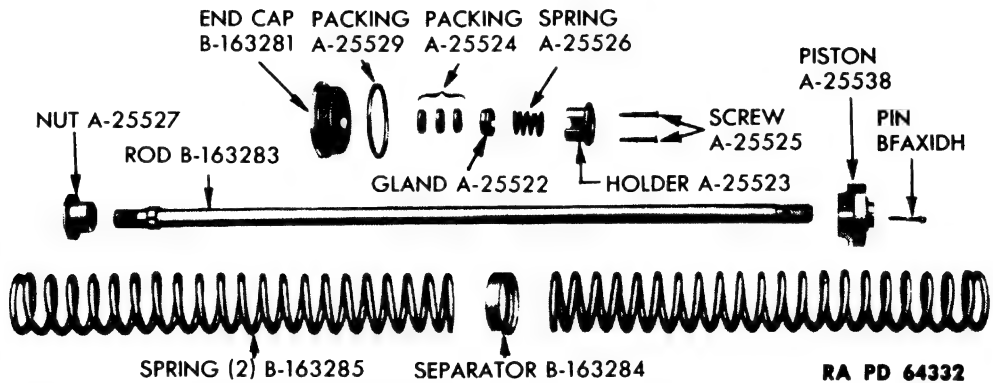


Figure 27—Recuperator Spring Assembly—Exploded View

- (6) Replace stuffing box packing and rear end cup packing.
- (7) Replace all cotter pins.

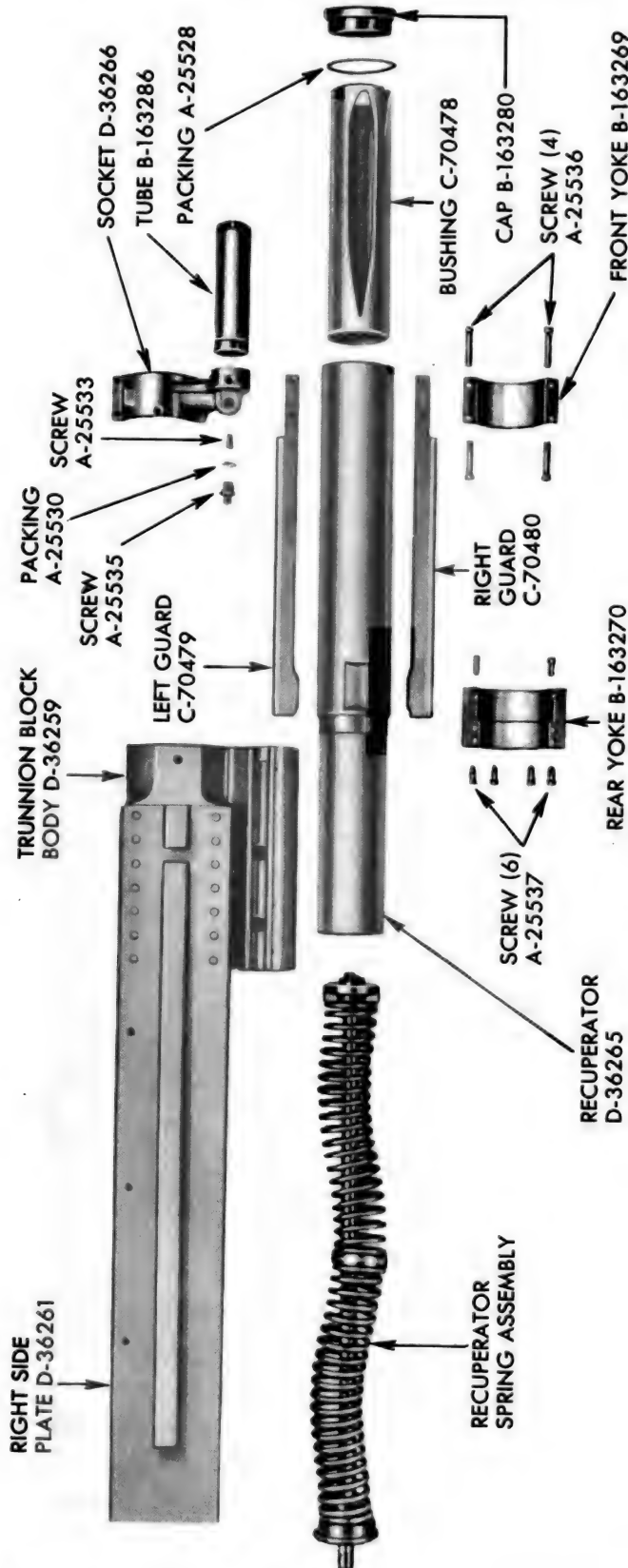
d. Assembly.

- (1) Place flat surfaces of rear end of recuperator piston rod B163283 securely in a vise.
- (2) Install rear end cap B163281 and packing A25529 with threaded end of cap up.
- (3) Carefully install stuffing box packing (three leather seals) A25524, gland A25522, spring A25526, holder A25523, and the two stuffing box screws A25525. Tighten screws evenly and stake them in place.
- (4) Install both recuperator springs B163285 on piston rod, with separator B163284 between them.
- (5) Use special clamp and two men to compress springs sufficiently to permit a third man to screw the piston A25538 on the piston rod until end of piston is flush with end of rod. The piston must be installed with the four steel seats toward the spring. Remove clamp.

e. Installation.

- (1) Make certain threads at middle of recuperator and in front end of trunnion block body are clean.
- (2) With a suitable clamp, screw recuperator D36265 into the trunnion block body until the shoulder on recuperator is tight against the front end of the body, and the driving spring tube guards on the trunnion block body are in alignment.
- (3) Install recuperator expansion tube socket D36266.
 - (a) Thoroughly tin (with solder) the front, upper end of the recuperator, where the expansion tube socket is to be installed.

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Figure 28—Recuperator and Recuperator Spring Assembly—Exploded View

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(b) Uniformly heat the expansion tube socket B163286 and thoroughly tin (with solder) the machined surface which bears against the recuperator. Also tin the countersunk holes for the three screw heads.

(c) While socket is still hot enough to melt solder, flow a heavy coating of solder all over the machined surface and immediately place the socket in position on the front end of the recuperator.

(d) Install the three recuperator expansion tube socket screws A25534, part way down. Then flow solder under each screw head and turn the screws down tight.

(e) Flow solder around the edges of the socket where it joins the recuperator. Inspect all joints between the socket and recuperator, and around the screws to make sure all joints are oiltight.

(f) Check drilled passages leading to expansion tube and filler hole, to make certain they are clear of solder.

(4) INSTALL DRIVING SPRING TUBE GUARDS.

(a) Install driving spring tube guard rear yoke B163270 on trunnion block body with two screws A25537 but do not tighten the screws.

(b) Place driving spring tube guards C70479 and C70480 on the recuperator with projecting portion of guards engaged in the recesses in the recuperator. Secure rear ends of the two guards to the rear yoke, with two screws A25537 in each guard, but do not tighten screws.

(c) Install driving spring tube guard front yoke B163269 with four screws A25536 extending through the yoke and the guards into the expansion tube socket.

(d) Now tighten all screws securely.

(5) INSTALL EXPANSION TUBE SOCKET.

(a) Make certain threads on expansion tube and in expansion tube socket are clean; then coat threads of tube with white lead, leaving the two end threads clean to avoid getting white lead into recuperator oil.

(b) Screw expansion tube tight into expansion tube socket.

(6) To install the recuperator spring assembly, place recuperator bushing in recuperator, making certain the lock indexes in groove in recuperator. Temporarily install recuperator front end cap B163280 to hold bushing in place.

(7) Install a suitable guard of sheet metal or heavy cardboard over bottom flanges of the side plates to prevent the possibility of scraping metal chips into recuperator.

(8) Coat packing A25229 and rear end cap threads with white lead, leaving the two end threads clean to avoid getting white lead into the recuperator oil.

(9) Slowly push recuperator spring assembly into rear opening of recuperator, turning and guiding it as required so that it will not contact and damage the threads in the rear end of recuperator.

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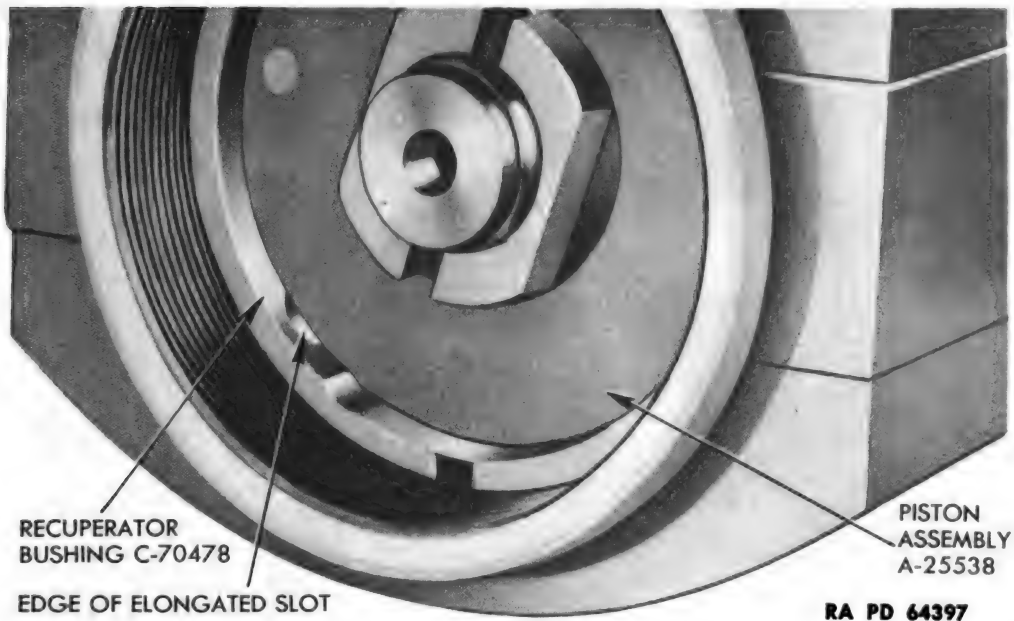


Figure 29—Recuperator Piston Adjustment

(10) Screw rear end cap tight into recuperator, using wrench B163290. This connection must be oiltight.

f. Adjust and Fill Recuperator. Before making this adjustment, the piston rod nut A25527 must be drawn up tight, and front and rear operating cam assemblies, tube extension, tube, accelerator cam, lock frame, driving spring assemblies, and back plate must be installed in gun.

(1) Remove recuperator front end cap B163280.

(2) Turn recuperator piston A25538 in a clockwise direction until the front edges of the elongated slots in the recuperator bushing just can be seen at the front edge of the piston.

(3) Press rearward on the bushing to make sure that it is seated against the shoulder in the recuperator. Then turn piston counterclockwise two complete revolutions, plus whatever is necessary to permit the cotter pin to be installed. Secure piston with a $\frac{1}{8}$ - by $1\frac{1}{4}$ -inch cotter pin BFAX1DH.

NOTE: A slight increase in the loading of the recuperator spring may be obtained by screwing the piston further down on its rod, but if this is carried to excess, it will uncover the ends of the throttling grooves and possibly cause serious damage by rendering the counterrecoil buffer inoperative. The rear face of the recuperator piston should cover the throttle openings at least $\frac{1}{16}$ inch.

(4) Place packing A25528 on front end cap. Coat packing and cap threads with white lead, leaving the two end threads clean to avoid get-

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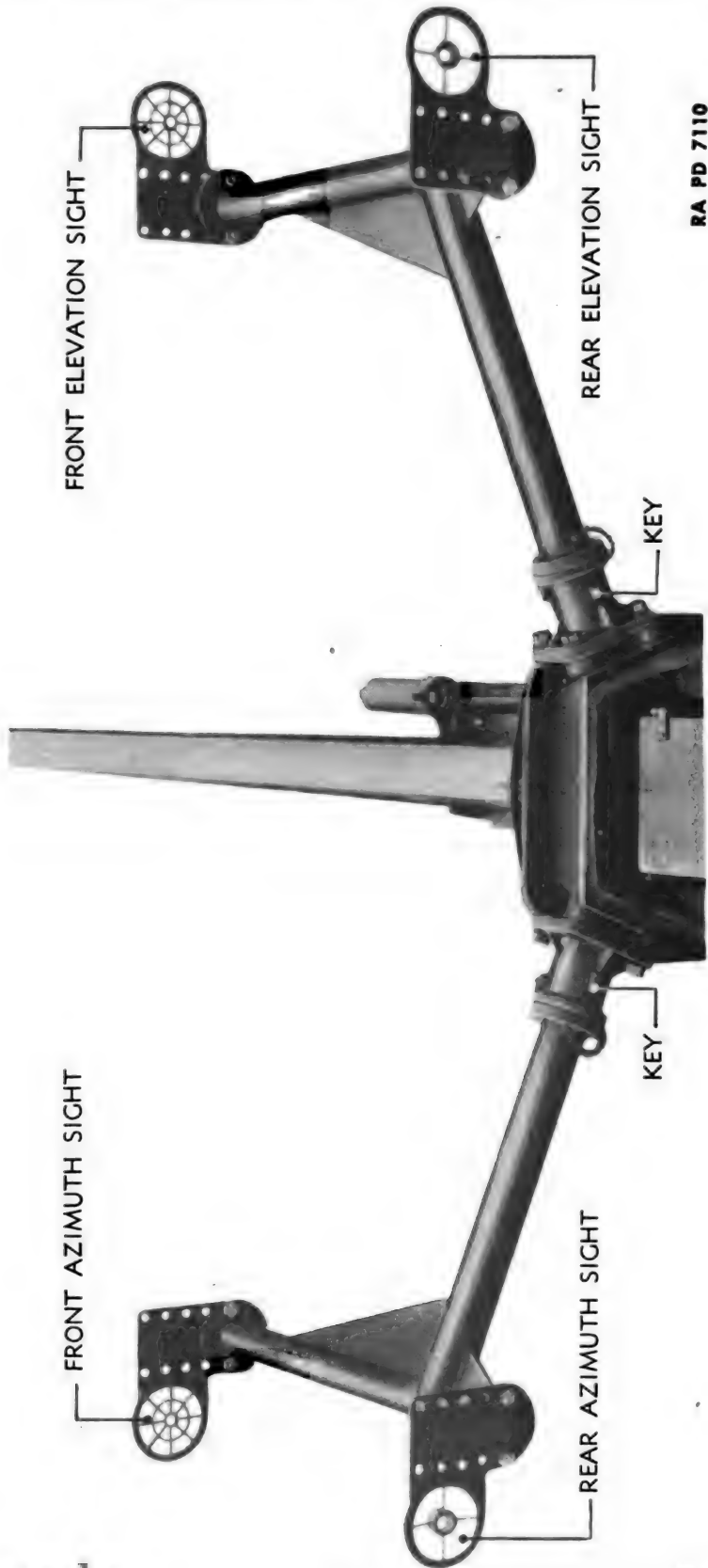


Figure 30—Direct Fire Sight

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Figure 31—Removing Sight Key

ting white lead into recuperator. Use wrench B163290 and make this connection oiltight.

(5) Tilt front end of gun upwards at an angle of five degrees. Slowly fill recuperator with OIL, recoil, light, while slapping sides of recuperator with hands to force air out during the filling operation. Continue filling and slapping until air is out and oil remains stationary at the bottom of the filler hole. Recuperator capacity is approximately $3\frac{1}{2}$ pints.

NOTE: If gun is in cradle, elevate gun to approximately 45 degrees, two or three times from five degrees. This will assist in eliminating air. If too much oil has been added, blow very gently through relief screw hole, and excess oil will overflow through filler hole.

(6) Install filler screw with packing; then install relief screw.

32. EQUILIBRATOR, M3 CARRIAGE.

a. Replacement of Equilibrator Spring.

(1) Remove the gun from the cradle.

(2) *Elevate the cradle to its maximum point.*

(3) Remove guard B161061 and cover B127840 from the end of the equilibrator.

(4) Remove nuts A146759 and A146758 from the piston rod. As nut A146758 is turned off the rod, the spring will extend to its free length.

(5) Remove guide A146760 and the equilibrator spring.

(6) Assemble in the reverse order of disassembly, using a new spring in place of the one removed.

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(7) Adjust the equilibrator as outlined in paragraph 34 f so that there will be equal ease in raising and lowering the gun and cradle.

b. Removal from Carriage.

- (1) Remove the gun from the cradle.
- (2) *Elevate the cradle to its maximum point.*
- (3) Remove the equilibrator spring as described in subparagraph a above.
- (4) Remove cotter pin BFAX1DF and drive out pin A146788.
- (5) Remove support B127839 by removing screws BCAX1BA and washer BECX1H.
- (6) The cylinder D26812 can now be removed from the carriage.
- (7) If it is necessary to examine or replace the bearing behind the equilibrator rod, remove screw BCGX3FF and unscrew cap A146789. The bearing is then accessible through the side of eye B127841.

c. Adjustment.

- (1) Elevate and lower the cradle and gun several times. Note the force required on the handwheel and the motion of the cradle. The cradle should rotate smoothly in its bearings and the handwheel force should not become excessively great.
- (2) The two nuts on the end of the piston rod can be adjusted to vary the compression of the equilibrator spring or springs. As the nuts are turned further on the rod, it will be easier to elevate the cradle and harder to depress it.
- (3) Equilibrator cylinder wrenches B161473 and B161474 are used to make the adjustment on the equilibrator cylinder.
- (4) If adjustment of the equilibrator cannot properly balance the gun and cradle, the spring or springs will have to be replaced.

33. EQUILIBRATOR, M3E1 CARRIAGE.

a. Replacement of Equilibrator Springs.

- (1) Remove the gun from the cradle.
- (2) *Elevate the cradle to its maximum point.*
- (3) Loosen stud A152297.
- (4) Unscrew head B181857.
- (5) Remove washer B181856, spring 152296, and stud A152297 by pulling out on the head.
- (6) The rest of the procedure is the same as that for the M3 Carriage.
- (7) Assemble in the reverse order of disassembly using a new spring or springs in place of the defective ones.

b. Removal from Carriage. This operation is similar to that for the M3 Carriage.

c. Adjustment. Adjustment of equilibrator is the same as that for the M3 Carriage.

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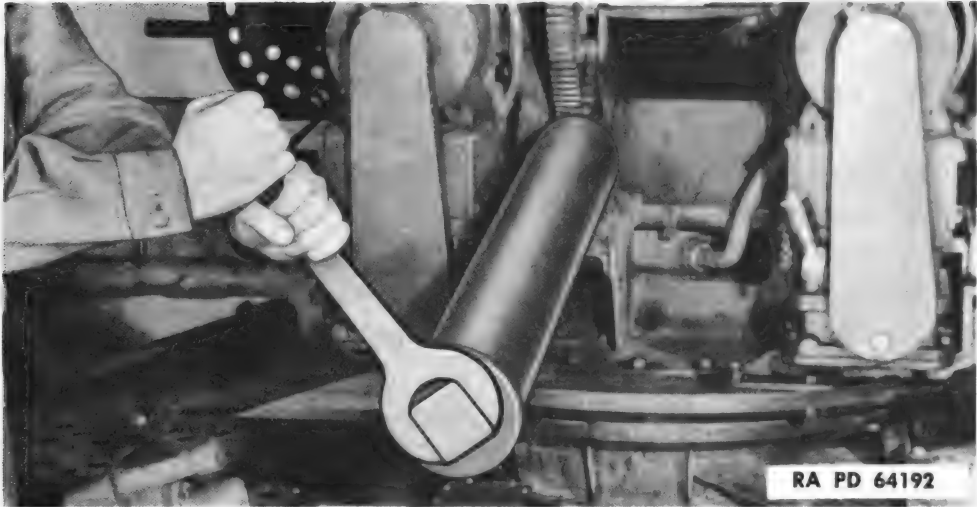


Figure 32—Removing Equilibrator Cap

34. EQUILIBRATOR, M3A1 CARRIAGE.

a. Removal. The following procedure is only necessary when the special spring compressor tool is not available. See subparagraph c below, for proper use of tool.

- (1) Lower gun to horizontal position and remove from cradle.
- (2) Remove cotter pin from equilibrator chain fastening pin A149100.
- (3) Remove equilibrator cap B162197, using special wrench B163292.



Figure 33—Inserting Wood Block in Equilibrator Cylinder

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- (4) Insert wood block into equilibrator cylinder D42333.
- (5) Replace equilibrator cap using special wrench, and screw down securely.
- (6) Elevate cradle to 90 degrees, or until equilibrator chain becomes slack.
- (7) Remove equilibrator chain fastening pin A149100, which secures equilibrator chain B162188 to elevating rack (fig. 36).
- (8) Remove four cap screws and lock washers from base of equilibrator cylinder, which secure cylinder to top carriage. Use $\frac{3}{4}$ -inch socket and ratchet, taking care to support end of cylinder as the cap screws are being removed.

CAUTION: Do not attempt to disassemble equilibrator off, or on carriage, without use of special tool (fig. 35).

b. Installation.

- (1) Position equilibrator assembly on top carriage, and install the four cap screws and lock washers, using $\frac{3}{4}$ -inch socket and ratchet.
- (2) Insert equilibrator chain fastening pin through chain eye and elevating rack.
- (3) Place gun in horizontal position and install cotter pin in equilibrator chain fastening pin.
- (4) Remove equilibrator cap, and remove wood block from inside of cylinder.
- (5) Replace equilibrator cap and tighten securely.

c. Disassembly (Equilibrator on Carriage). It is not necessary to remove equilibrator assembly from top carriage in order to disassemble, if spring compressor tool is available.

CAUTION: Do not stand in front of equilibrator, in line with cap, when disassembling the unit, as serious personal injury may occur, should the compressed equilibrator spring be accidentally released.

- (1) Remove gun from cradle.
- (2) Place cradle in horizontal position and remove cotter pin from chain fastening pin A149100.
- (3) Remove equilibrator cap B162197, using special wrench B163292 (fig. 32).

This is suggested in the event the same spring is reinstalled and will permit equilibrator spring to be set to original adjustment.

- (4) Screw spring compressor tool in place on end of equilibrator cylinder, taking care to align setscrew in tool housing with hole in equilibrator cylinder D42333. Tighten setscrew in tool housing.

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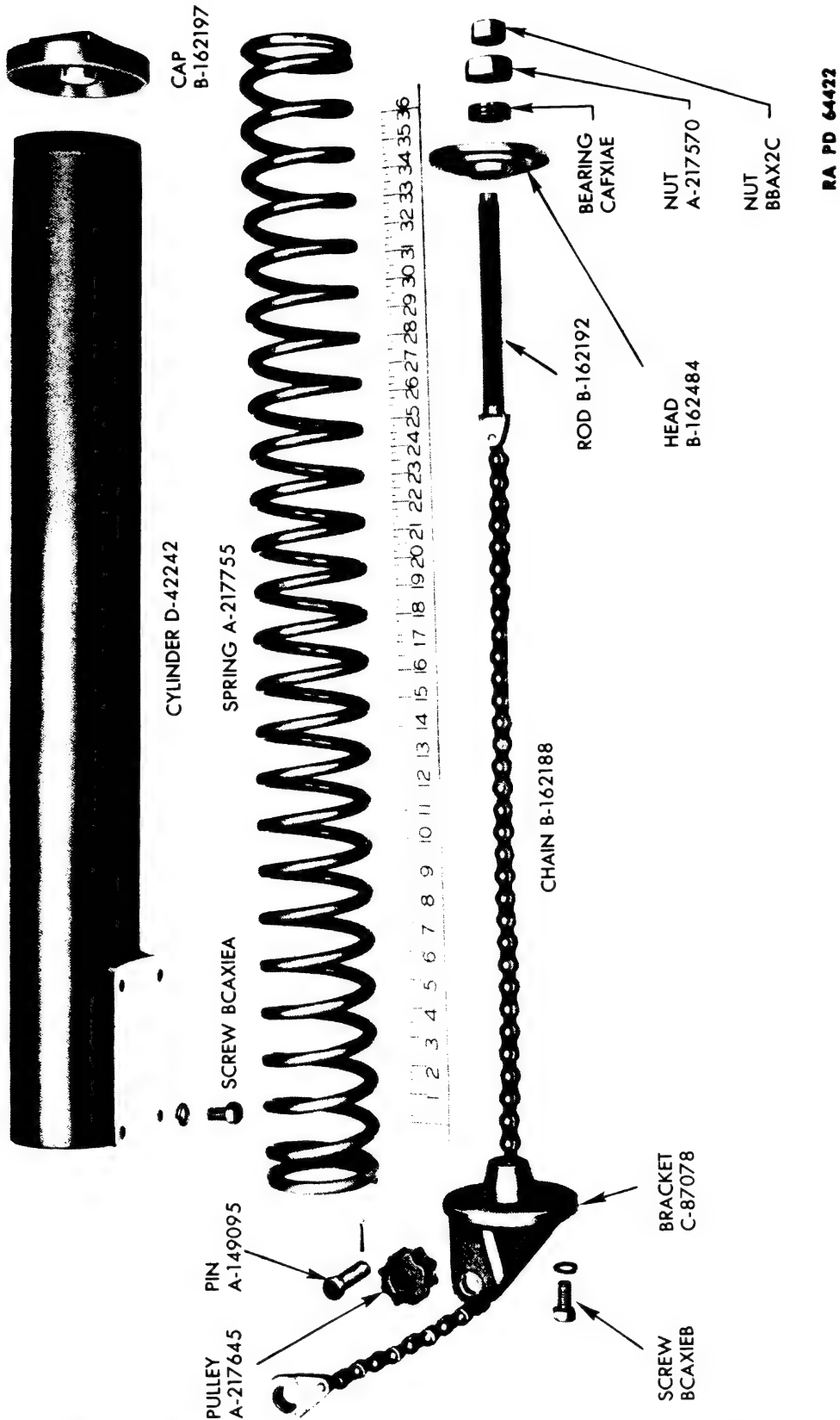


Figure 34—Equilibrator Assembly, M3A1 Carriage—Exploded View

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Figure 35—Equilibrator Spring Compressor Tool

(5) Tighten screw in tool so that equilibrator chain B162188 is slack, and remove equilibrator chain fastening pin A149100, which secures chain to elevating rack D42235.

(6) Back off screw in spring compressor tool by turning it in counter-clockwise direction until all tension is off the screw and only the connecting eye of chain extends out of rear end of cylinder.

(7) Loosen lock screw in tool and unscrew tool from the end of equilibrator cylinder.

NOTE: Measure distance, or count the number of threads of the extended equilibrator chain rod, from end of rod to lock nut BBAX1C. This is suggested in the event the same spring is reinstalled and will permit equilibrator spring to be set to original adjustment.

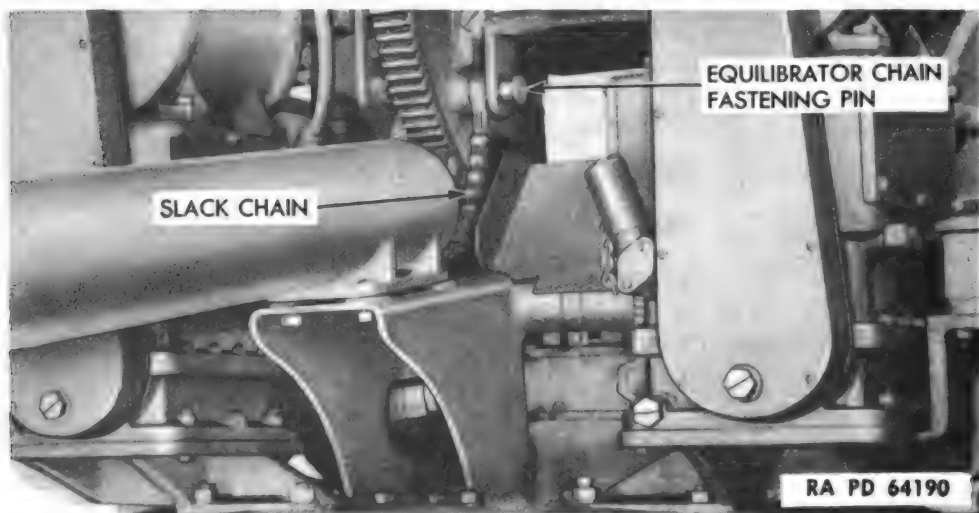
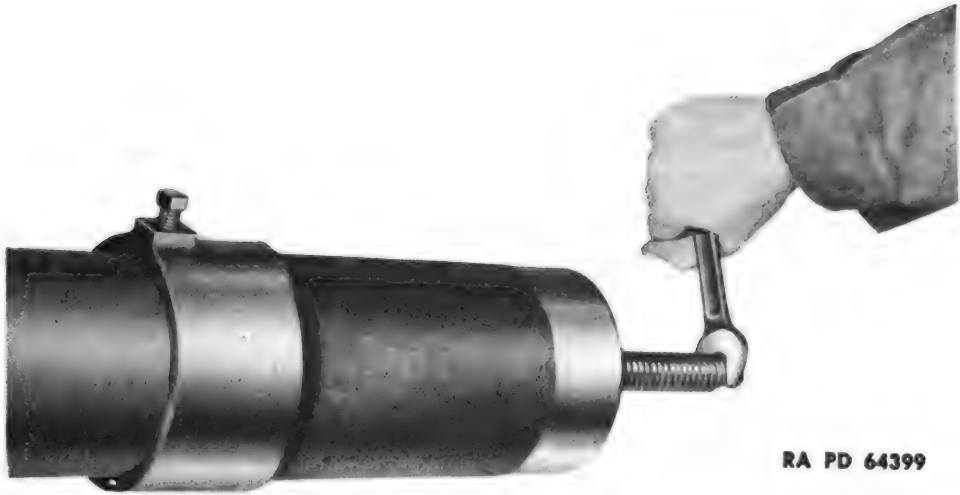


Figure 36—Removing Equilibrator Chain Fastening Pin

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Figure 37—Using Equilibrator Spring Compressor Tool

(8) Using wrenches B161473 and B161474, fit large wrench B161474 over equilibrator chain rod nut A217570 and insert small wrench B161473 through large wrench and fit over lock nut BBAX2C.

(9) Remove both nuts from equilibrator chain rod B161192. Remove bearing CAFX1AE and equilibrator cylinder head B162484, and withdraw equilibrator spring A217255.

(10) Remove equilibrator bracket C87078 by removing four cap screws, using $\frac{3}{4}$ -inch socket short extension and ratchet and remove equilibrator guide pulley A217645 by removing cotter pin and withdrawing pin A149095 from pulley.



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Figure 38—Equilibrator Wrenches

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NOTE: It is necessary to unrivet the chain eye from equilibrator chain to withdraw the chain rod from cylinder. This need not be done unless inspection shows damage to chain or rod.

d. Inspection.

(1) Clean all parts free of dirt and grease; polish discolored or corroded parts with CLOTH, crocus, or crocus paper and oil.

(2) Inspect bearing CAFX1AE; replace if rough in movement.

(3) Inspect head B162484; inspect spring A217755 and measure free length. New spring is approximately 40 inches in length.

(4) Inspect chain rod B162192 and chain B162188, for possible weakness in links or eye.

(5) Replace all cotter pins. Replace chain fastening pin A149100 if worn.

(6) Inspect cylinder D42333 for dents or misshapen condition.

e. Assembly (Equilibrator on Carriage).

(1) Grease and install equilibrator spring A217255 in cylinder.

(2) Place equilibrator cylinder head B162484 on equilibrator chain rod B162192 within equilibrator cylinder D42333.

(3) Install bearing CAFX1AE, chain rod nut A217570, and lock nut BBAX2C on chain rod.

(4) Screw spring compressor tool in place on end of cylinder, taking care to align setscrew in tool housing with hole in cylinder. Tighten setscrew in tool housing.

(5) Turn center screw of tool clockwise, compressing spring until sufficient slack is available in chain to permit attachment to elevating rack. Insert equilibrator chain fastening pin A149100.

(6) Lower gun to horizontal position and insert cotter pin in chain rod fastening pin.

(7) Loosen setscrew in spring compressor tool housing, and unscrew spring compressor tool from cylinder.

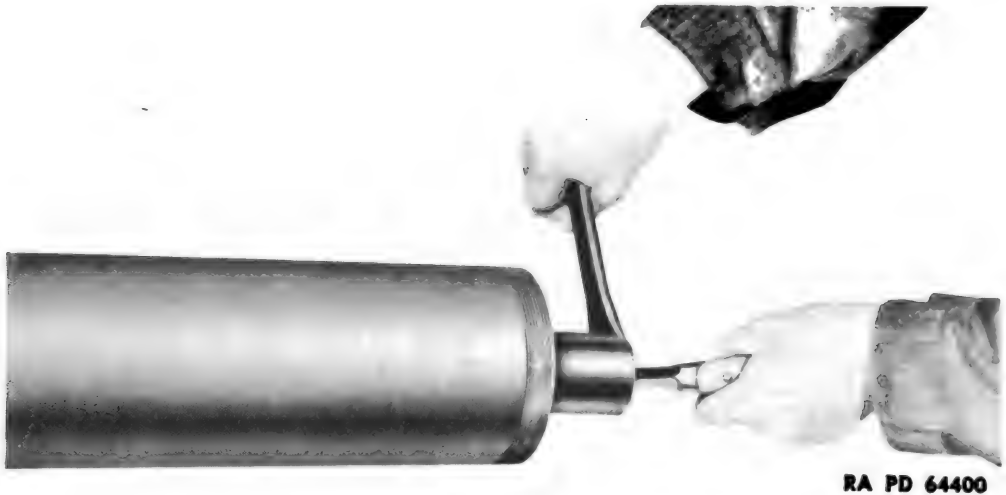
(8) Install gun in cradle.

f. Adjustment.

(1) Elevate gun to 90 degrees.

(2) Using wrenches B161473 and B161474, fit large wrench B161474 over equilibrator chain rod nut A217570 and insert small wrench, fitting it over lock nut BBAX2C. Screw both nuts on equilibrator chain rod firmly against cylinder head. Use a hooked spring scale and measure effort required to elevate and depress gun. It can be no more than 10 pounds or gun will not perform by remote control. If greater effort is

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Figure 39—Adjusting Equilibrator Spring

required to lower the gun than to raise the gun, adjust by turning chain rod nut in a counterclockwise direction. If effort is greater to raise the gun, turn chain rod nut in a clockwise direction. Hold chain rod securely with machinist screwdriver while chain rod nut is being loosened or tightened. The lock nut must, of course, be backed off slightly from the chain rod nut when the latter is being loosened.

CAUTION: Be sure to keep lock nut on chain rod at all times during adjustment of equilibrator spring, to avoid spring pressure being accidentally released. Tighten lock nut securely against chain rod nut when adjustment of spring is completed.

(3) Replace equilibrator cap and tighten securely.



RA PD 64401

Figure 40—Tightening Lock Nut Against Adjusting Nut

RA PD 6525

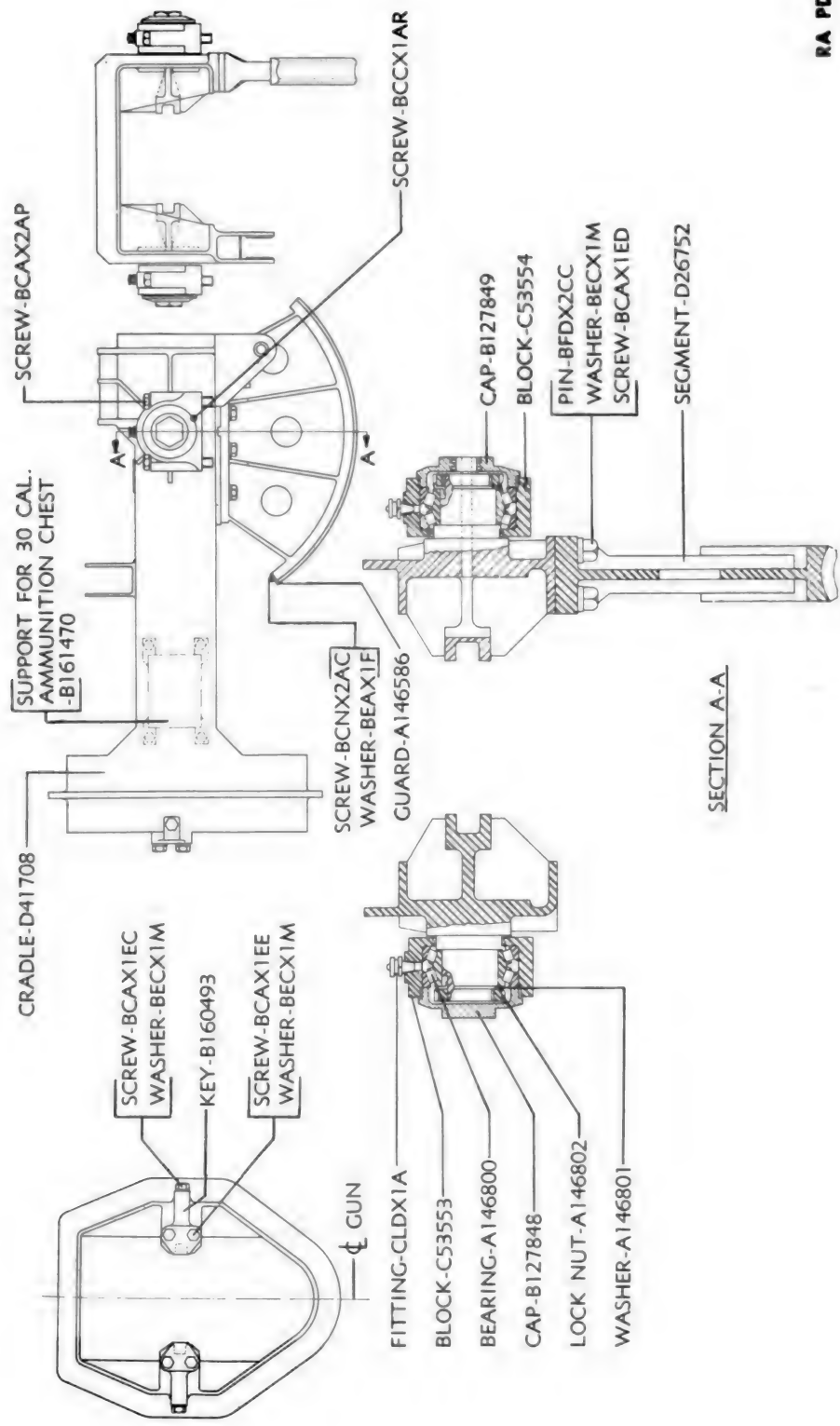
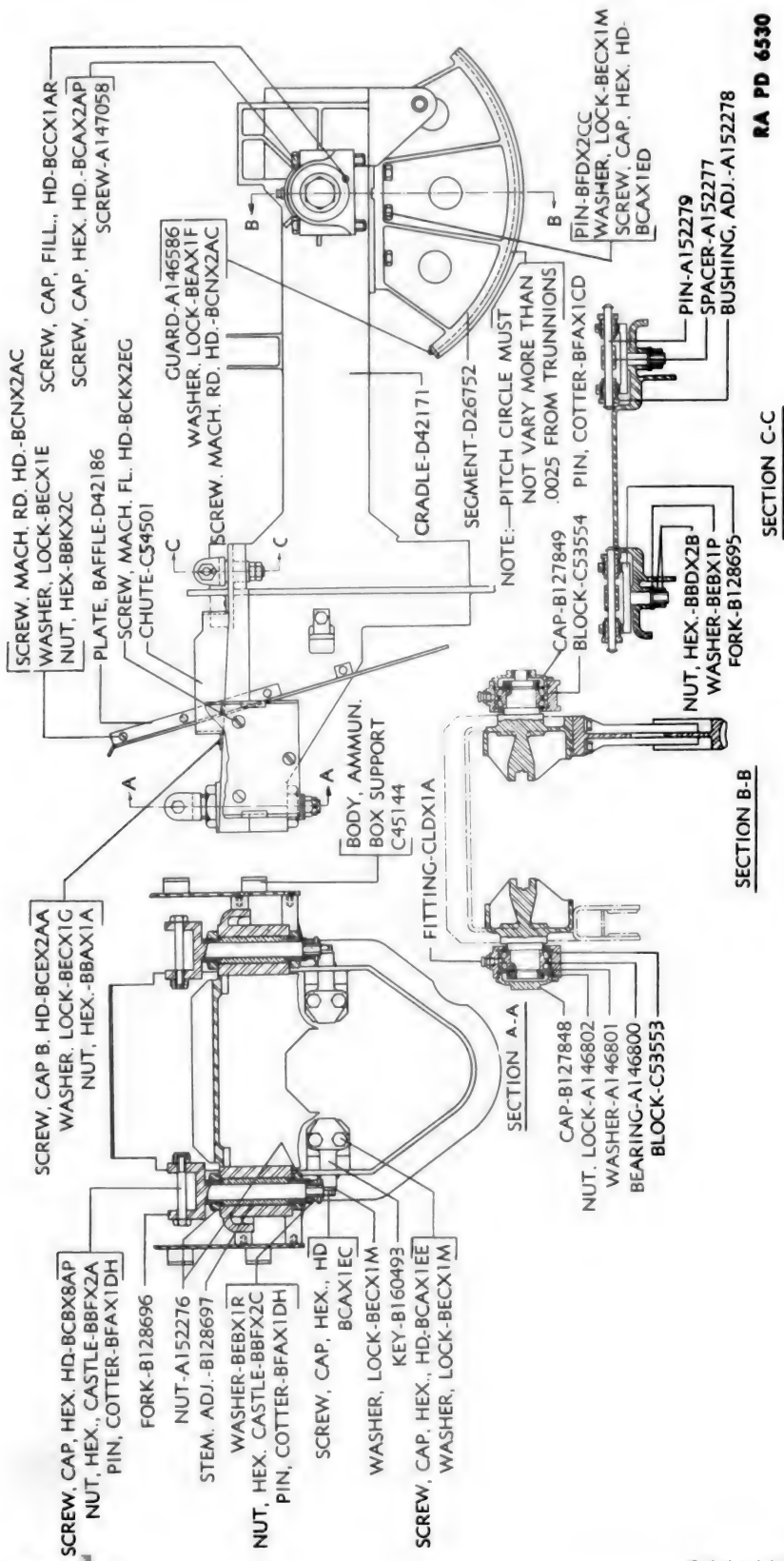


Figure 41—Cradle Assembly, M3 Carriage

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Figure 42—Cradle Assembly, M3E1 Carriage

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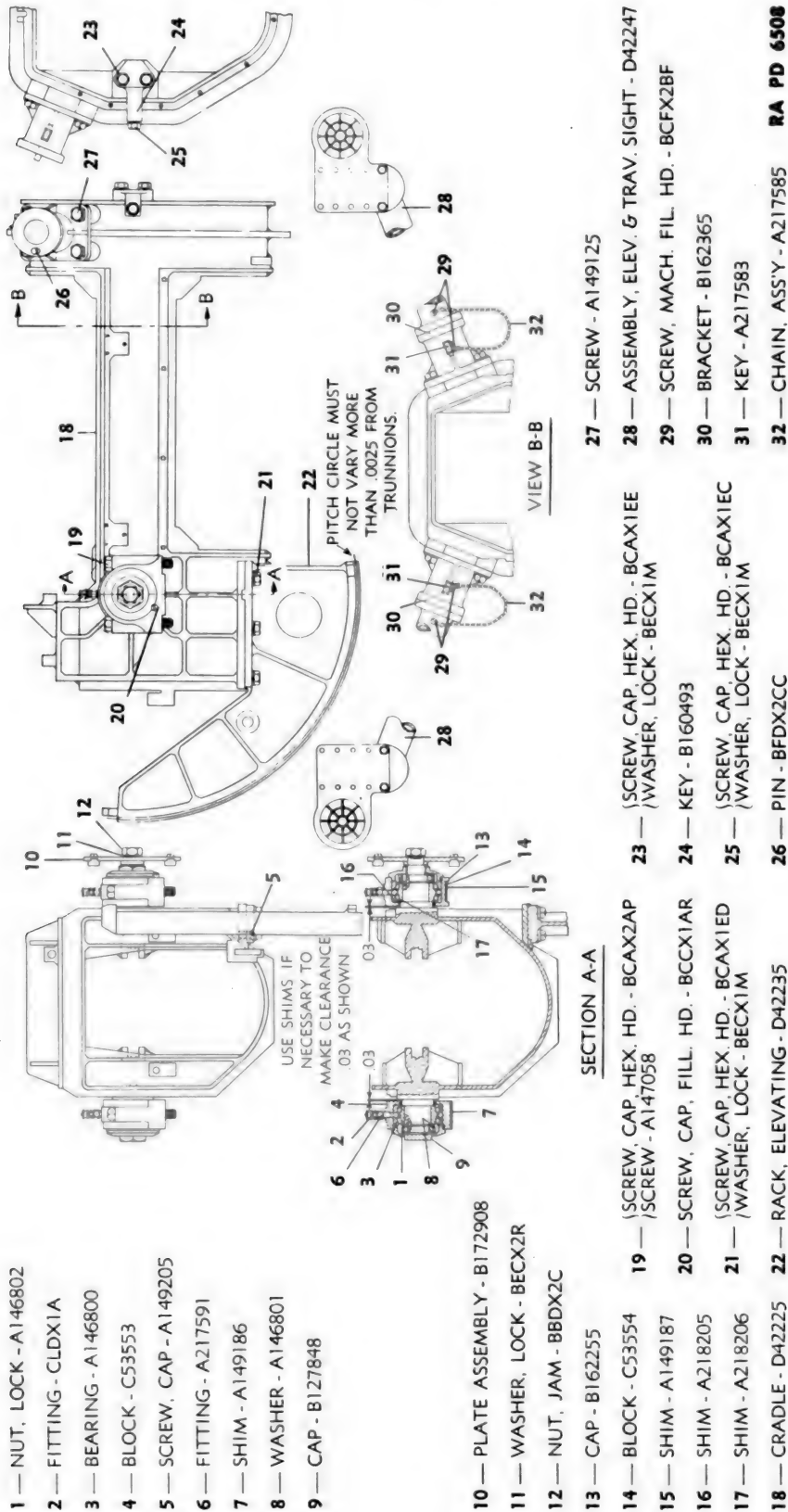


Figure 43—Cradle Assembly, M3A1 Carriage

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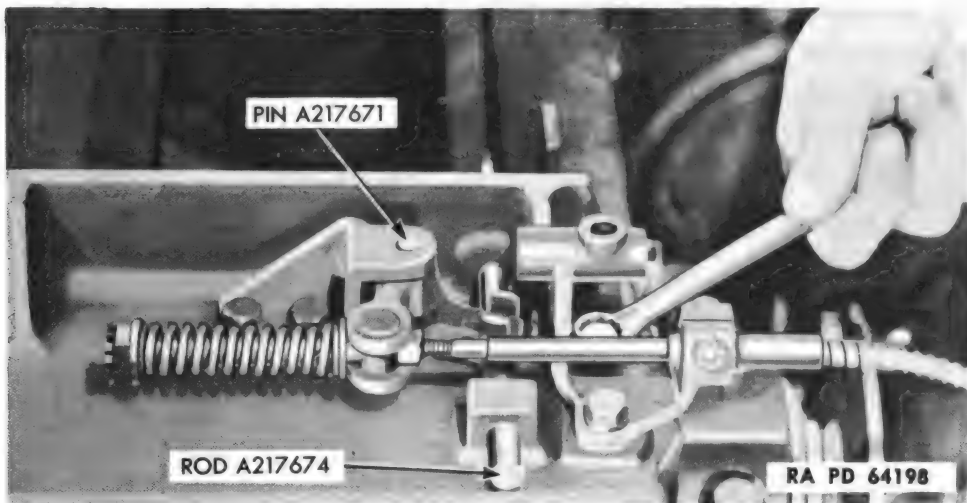


Figure 44—Disconnecting Foot Firing Mechanism Cable from Cradle
35. CRADLE ASSEMBLY.

a. **General.** On the M3, M3E1, and M3A1 Carriages the cradles have the same bearings and trunnion attachments to the top carriages. The keys and slideways for the gun are the same, as well as the method of securing the elevating rack to the cradles. The M3A1 Cradle is connected to the equilibrator by means of a chain, whereas the other cradles are connected to the equilibrator by means of a rod and eye.

b. **Removal.** To remove the cal. .50 machine gun from the cradle of the M3E1 Carriage, proceed as follows:



Figure 45—Removing Cut-out Switch Plate Assembly

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(1) Remove nuts BBDX2B from the bottom and front end of the cal. .50 gun, disconnect the firing mechanism from the gun, and lift the gun, together with the forks, from the cradle. Mounting of the cal. .50 machine gun is accomplished by reversing the aforementioned procedure.

(2) Remove gun from cradle.

(3) Remove direct fire sights from cradle.

(4) Disconnect equilibrator chain from elevating rack as described in paragraph 34 a.

(5) Remove foot firing mechanism from cradle by removing two cap screws and lock washers from foot firing trunnion cable bracket B162437 and two cap screws from foot firing trunnion cam bracket B162436, using a $\frac{9}{16}$ -inch wrench for the four screws. Withdraw foot firing trunnion rod A217674.

(6) Remove cut-out switch plate assembly B172908 by removing nut and lock washer.

(7) Remove four cradle trunnion bearing block screws A147058, using small screwdriver.

(8) Remove four cap screws BCAX2P from bearing blocks, using a $\frac{7}{8}$ -inch wrench.

(9) Rig cradle and lift from carriage with chain hoist, or have four men lift cradle from carriage.

NOTE: Each trunnion is shimmed. When cradle is lifted from top carriage be sure to mark shims, or wire them to trunnion, so that they can be replaced correctly.

c. Disassembly. The elevating rack should not be removed unless for replacement, as it is mounted to the cradle with precision gages, and any variance in excess of 0.0025 inch from the center of the trunnion to either end of elevating rack will interfere with proper action of the elevating mechanism. If, however, the rack is damaged, it can be removed by turning cradle upside down, and removing five cap screws and lock washers, using a $\frac{3}{4}$ -inch wrench, and removing one flat-head screw at rear end of inner flange.

(1) Remove two fillister-head setscrews from cradle trunnion bearing caps B127848 and B162255, and one screw from each bearing cap, and unscrew bearing caps.

(2) Remove two bearing lock nuts A146802 and washers A146801.

(3) Remove two bearings A146800.

NOTE: Two shims A218205 and A218206 are under the trunnion

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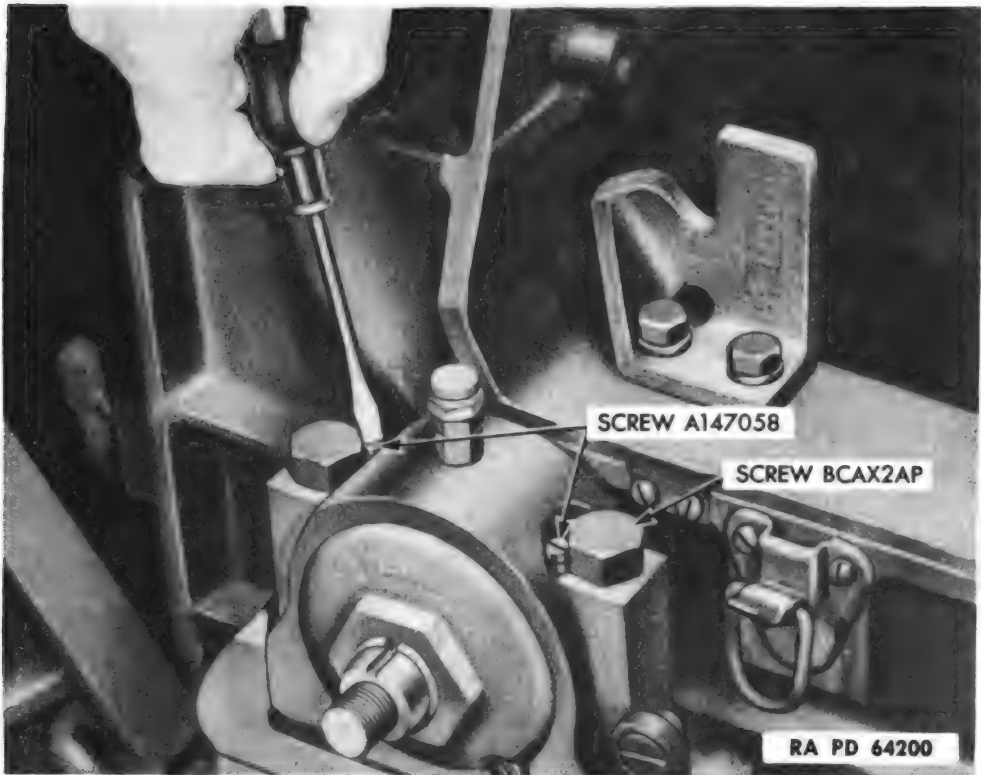


Figure 46—Removing Trunnion Bearing Block Screws

bearing blocks. Be sure to preserve these shims, so proper replacement can be made.

(4) Remove both trunnion bearing blocks C53553 and C53554.

(5) Remove both sight brackets B162365 by removing four cap screws, two from each bracket, using a $\frac{3}{4}$ -inch wrench.

(6) Remove foot firing trunnion bracket B162203 by removing two cap screws and lock washers, using a $\frac{9}{16}$ -inch wrench.

d. Inspection. Upon disassembly of cradle, all parts should be thoroughly cleaned and inspected for wear, bends, cracks, and breakage. Particular care should be taken to see that all shields, covers, etc., fit correctly and all catches and fasteners operate smoothly.

e. Assembly.

(1) Replace foot firing trunnion bracket, using a $\frac{9}{16}$ -inch wrench to secure two cap screws and lock washers.

(2) Replace two sight brackets, using a $\frac{3}{4}$ -inch wrench to replace four cap screws, two in each bracket.

(3) Install both trunnion bearing blocks.

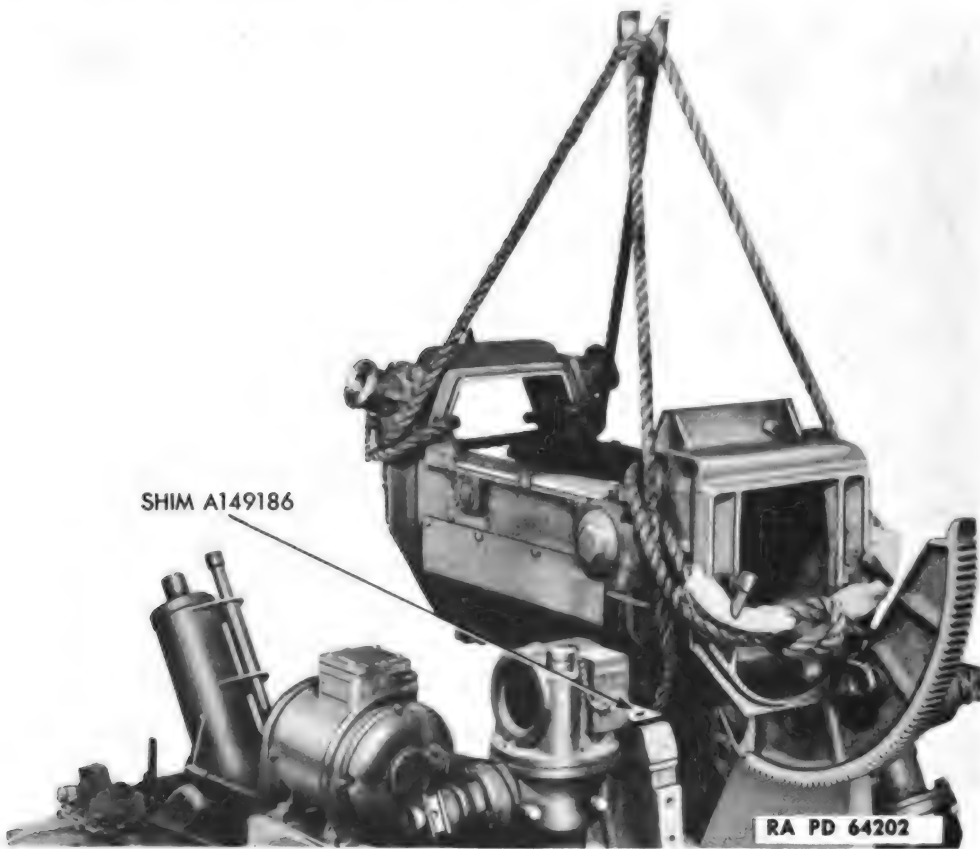


Figure 47—Lifting Cradle from Top Carriage

(4) Replace two bearings, one in each bearing block, and adjust bearing lock nut against each bearing securely.

(5) Replace bearing caps.

(6) Replace setscrews in each bearing cap.

(7) Replace cut-out switch plate, replacing nut and lock washer.

f. Installation. When assembling cradle to the M3 and M3E1 Carriages, it will be necessary to turn the elevating handwheel as far as possible in the "depress" direction. Then assemble the cradle to the carriage at a 0-degree elevation and mark the teeth of the rack that engage the worm.

(1) Using chain hoist or other suitable means, lift cradle, and lower to top carriage, being careful to position shims correctly. Aline trunnion bearing blocks exactly, so that cradle will seat evenly in machined recesses.

(2) Replace four cradle trunnion bearing block screws.

(3) Install gun in cradle.

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(4) Install direct fire sights.

(5) Attach equilibrator chain to elevating rack as described in paragraph 34 e.

(6) Attach foot firing mechanism to cradle by installing two cap screws and lock washers in foot firing cam bracket. Insert foot firing trunnion rod. Attach foot firing cable bracket, by installing two cap screws and lock washers.

NOTE: After installing cradle on M3 and M3E1 Carriages, operate the elevating handwheel to its limits in each direction and note whether the cradle goes through its range of 0 to 85 degrees in elevation. If not, the cradle will have to be removed and replaced with teeth adjacent to the marked ones in engagement with the worm. Test again to note the position of the cradle with respect to the elevating handwheel. When the stops of the elevating mechanism allow the cradle to go through its entire range, tighten the blocks securely in place.

36. PLATFORM ASSEMBLY.

a. Removal.

(1) Remove seat assemblies, right and left, from platform by taking out cotter pin and removing wing nuts A147859 and washers BEBX2K from under side of seat assembly posts, and lift seat assemblies from platform.

(2) Detach short foot firing cable from front foot firing pedal by tapping out taper pin in bracket of left front firing pedal and remove the screw A149119. Unscrew clevis from end of cable and loosen cap screws securing cable clamp bracket. Withdraw cable from bracket and remove foot firing cable bracket from under side of platform.

(3) Remove platform assembly D42303 by removing 14 nuts BBAX1E and lock washers BECX1M from under side of top carriage brackets, right D42248, center D42241, and left D42244, and lift platform assembly from carriage.

b. Disassembly.

(1) Remove 17 flat-head screws which attach platform to the three top carriage brackets.

(2) Remove two nuts BBAX1C from screws BCAX1CB which hold rear pedal plunger bracket B162438 to platform. Remove bracket assembly.

(3) Remove four screws BCAX1CC from upper side of platform and remove rear pedal shaft bracket A149140 assembly. Remove pedal and assembly.

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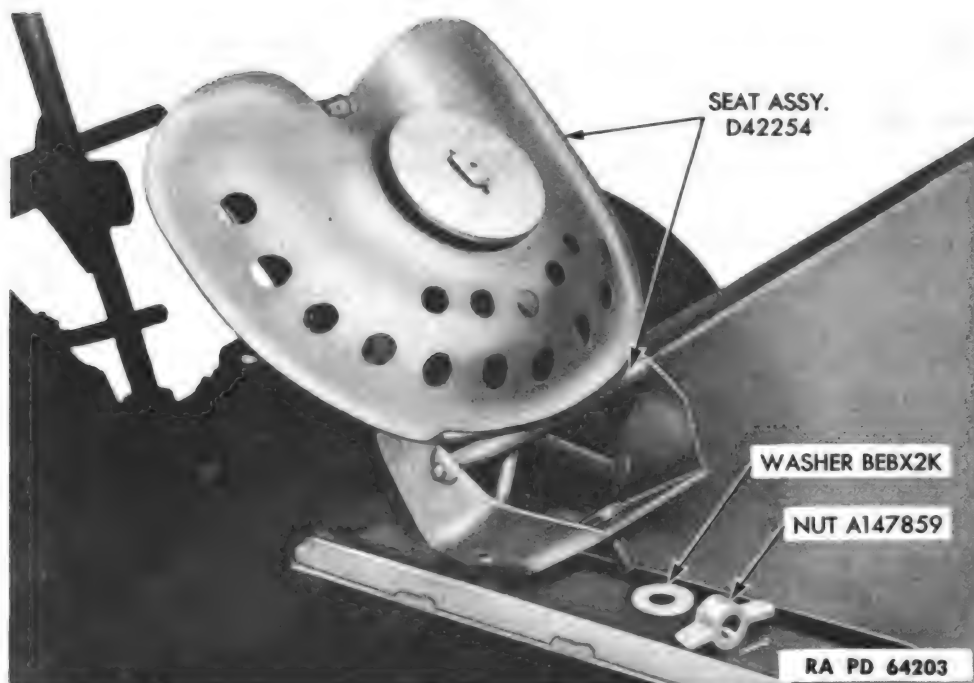


Figure 48—Removing Seat Assembly from Platform

c. Assembly.

- (1) Place rear pedal shaft bracket assembly A149140 in position;



Figure 49—Removing Foot Firing Cable Bracket

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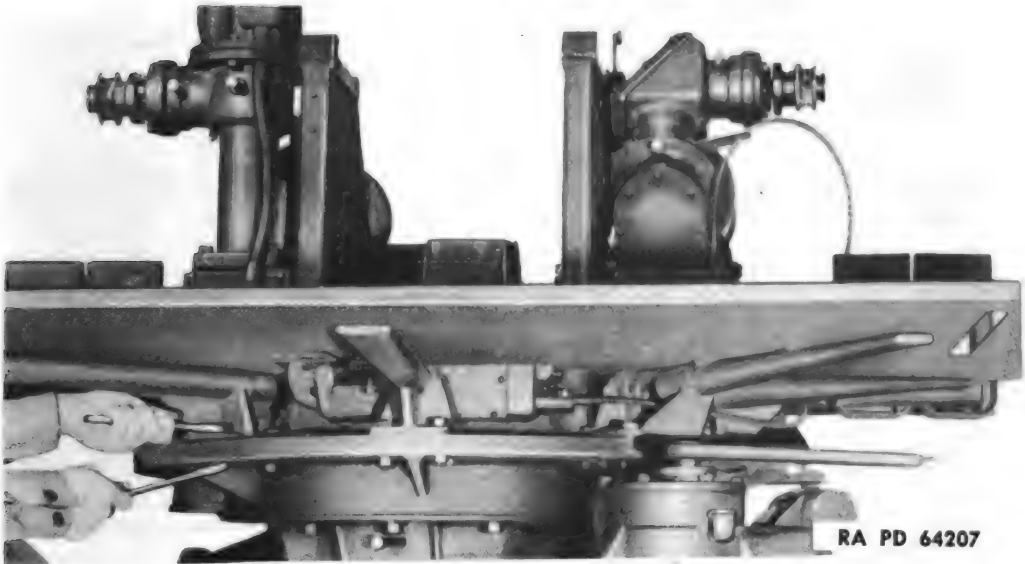


Figure 50—Removing Nuts from Top Carriage Bracket

install rear pedal C53756 and secure with four screws BCAX1CC, washers, and nuts BBAX1C.

- (2) Attach rear pedal plunger bracket assembly B162438 to platform



Figure 51—Dismounting Top Carriage Brackets from Platform Assembly

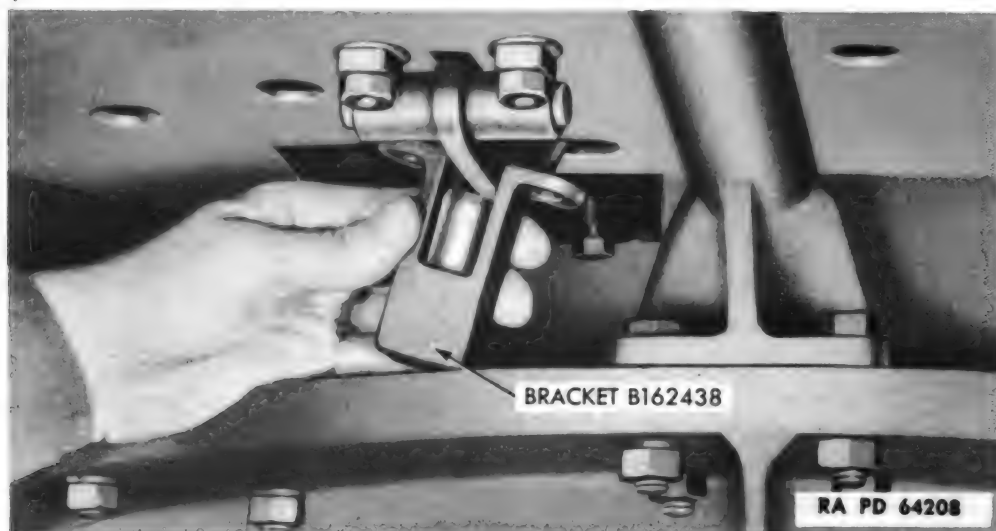


Figure 52—Removing Rear Pedal Plunger Bracket Assembly

and secure with two screws BCAX1CB, washers, and nuts BBAX1C.

(3) Mount the three platform brackets on under side of platform and secure with 14 screws.

d. Installation.

(1) Place platform assembly, with top carriage brackets installed, on top carriage and secure brackets to carriage with 14 cap screws; tighten nuts BBAX1E from under side of carriage.

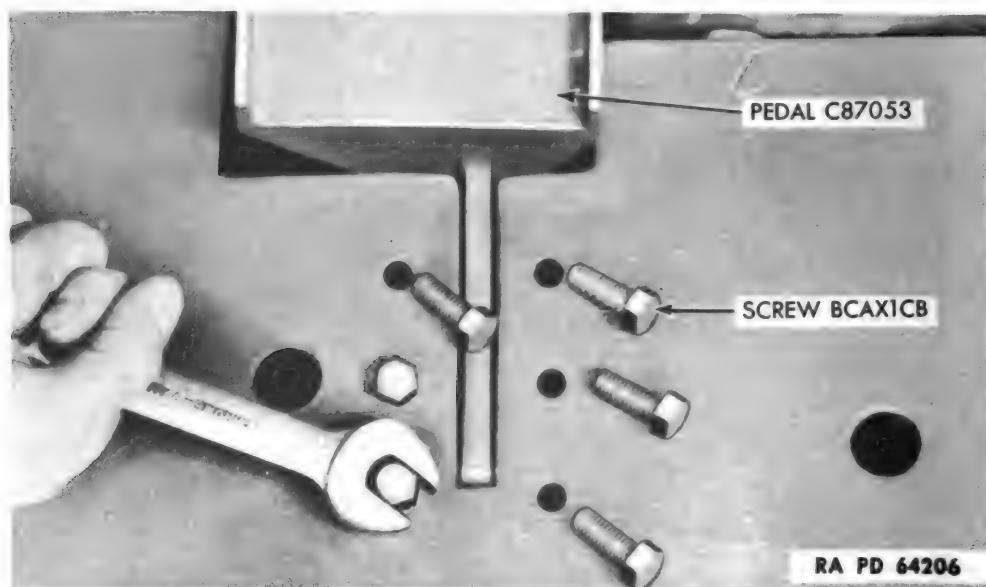


Figure 53—Removing Rear Pedal Shaft Bracket Assembly

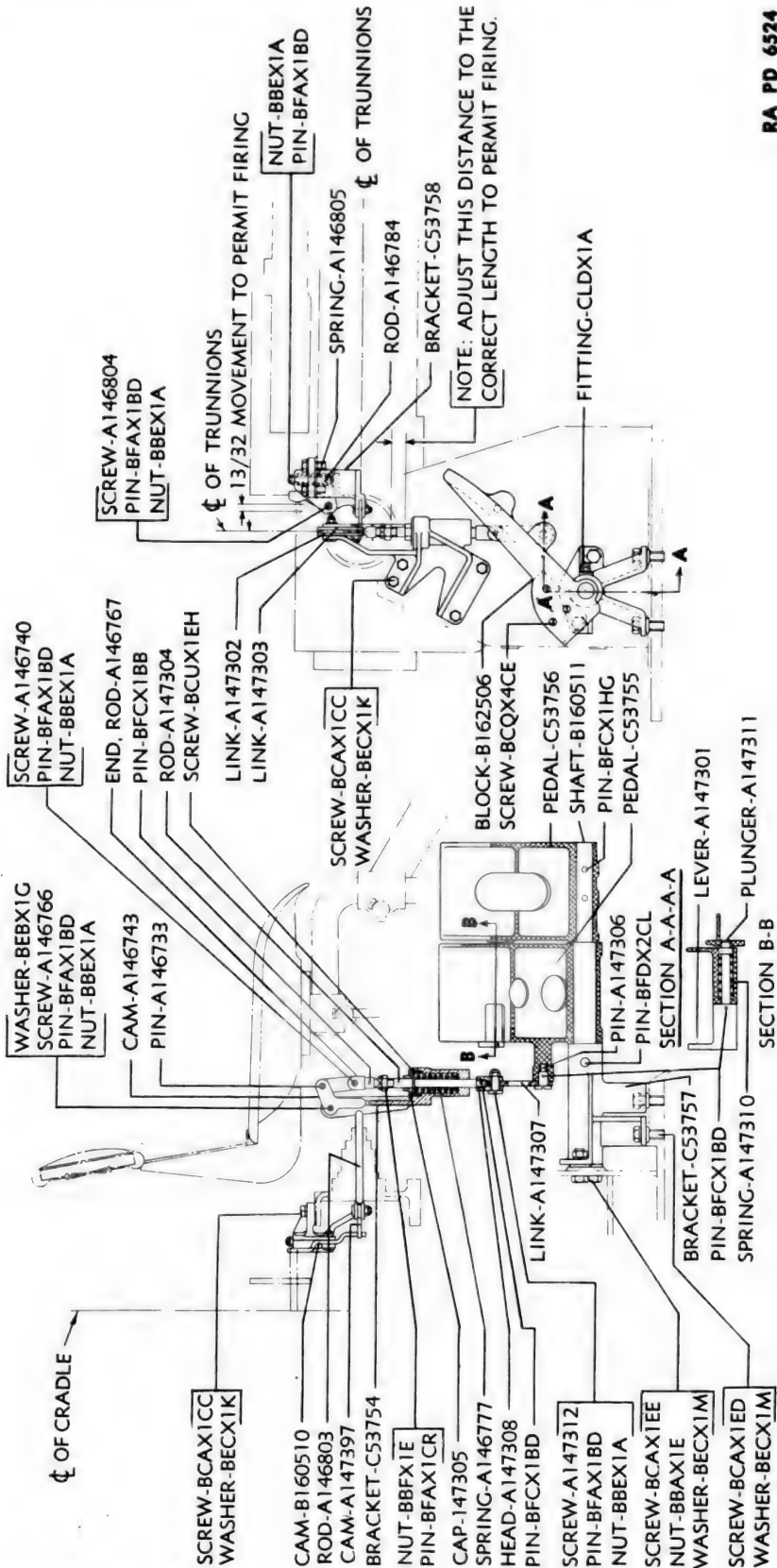
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RA PD 5767

Figure 54—Foot Firing Mechanism for 37-mm Gun and 2 Cal. .50 Guns

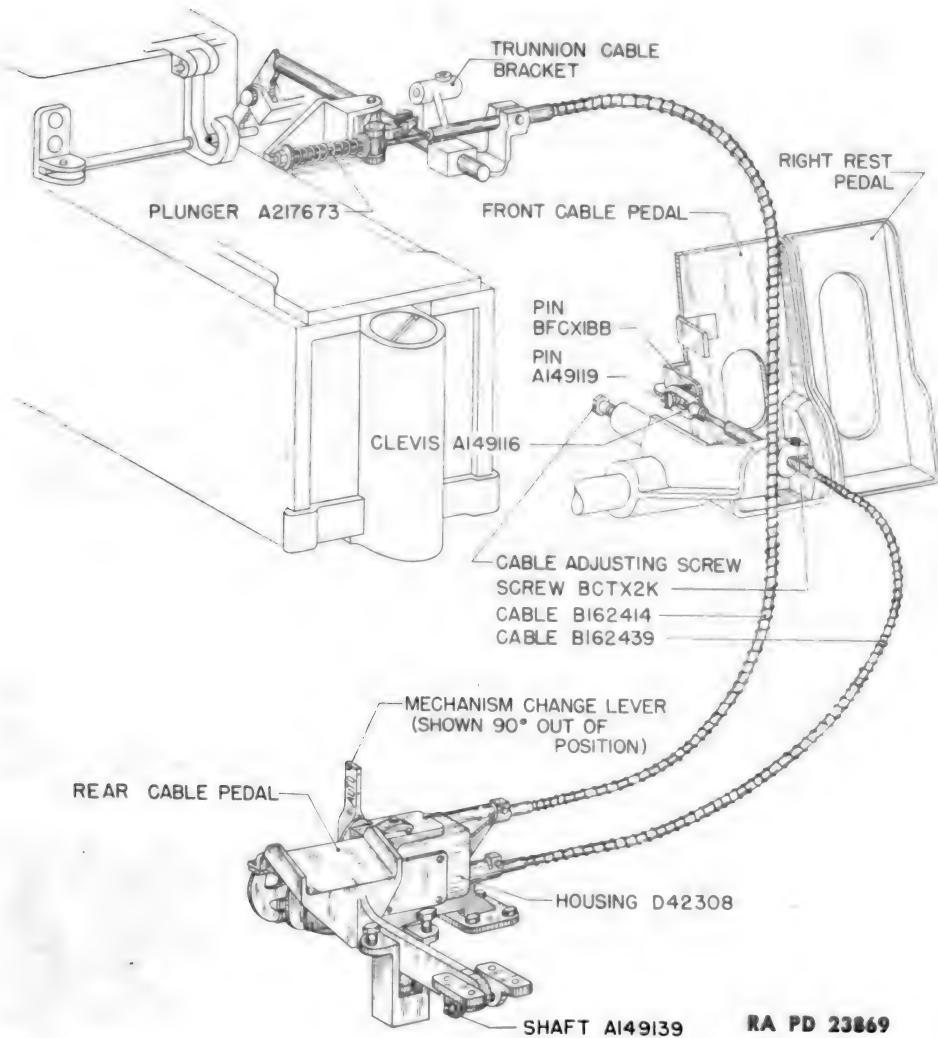
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RA PD 6524

Figure 55—Foot Firing Mechanism Assembly, M3 and M3E1 Carriages

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Figure 56—Foot Firing Mechanism, M3A1 Carriage

(2) Attach short foot firing cable to front foot firing pedal, and also attach cable bracket on under side of platform, and adjust as described in paragraph 37 h.

(3) Install two seat assemblies on platform, inserting seat posts through long slots in platform and secure with wing nuts and cotter pins.

37. FOOT FIRING MECHANISM, M3 AND M3E1 CARRIAGES.

a. General.

(1) **M3 CARRIAGE.** The elevating operator is provided with two foot pedals, the left one acting as a control for firing the gun. This foot pedal is provided with a latch lever which is located to the left of the pedal.

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Figure 57—Tapping Out Taper Pin

The operator fires the gun by disengaging the latch, doing so by pressing the lever to the left and then pushing the pedal down. The gun trigger remains pulled as long as the foot pedal is depressed. When pressure on the pedal is released the pedal rises and the latch automatically locks



Figure 58—Removing Foot Firing Cable Pedal Screw

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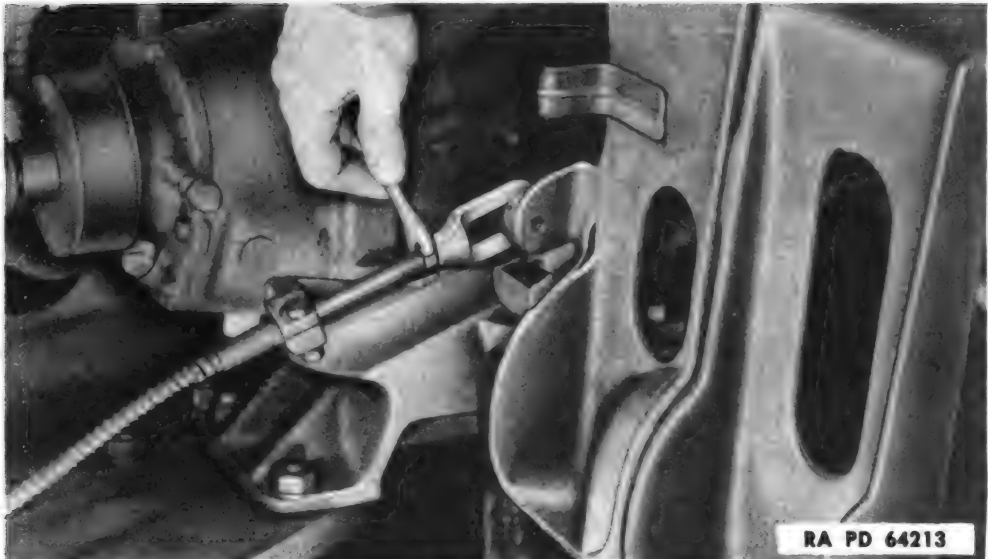


Figure 59—Loosening Clevis Nut

the pedal. A mechanical system of levers and links carries the motion of the foot pedal through the right trunnion bearing and the trigger connector bracket lever which passes through the hole of the trigger.

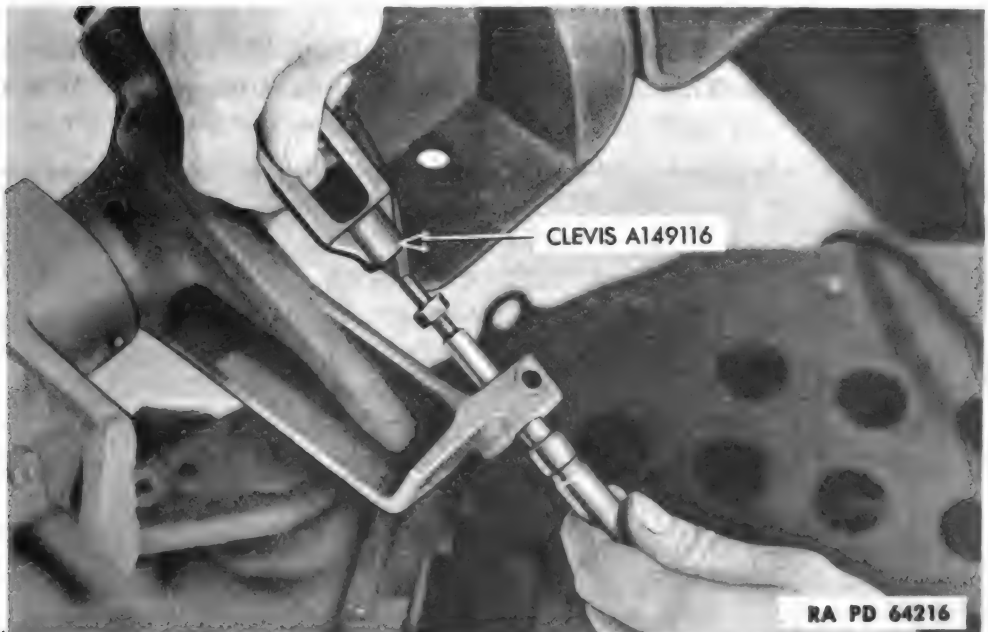


Figure 60—Removing Clevis from Cable

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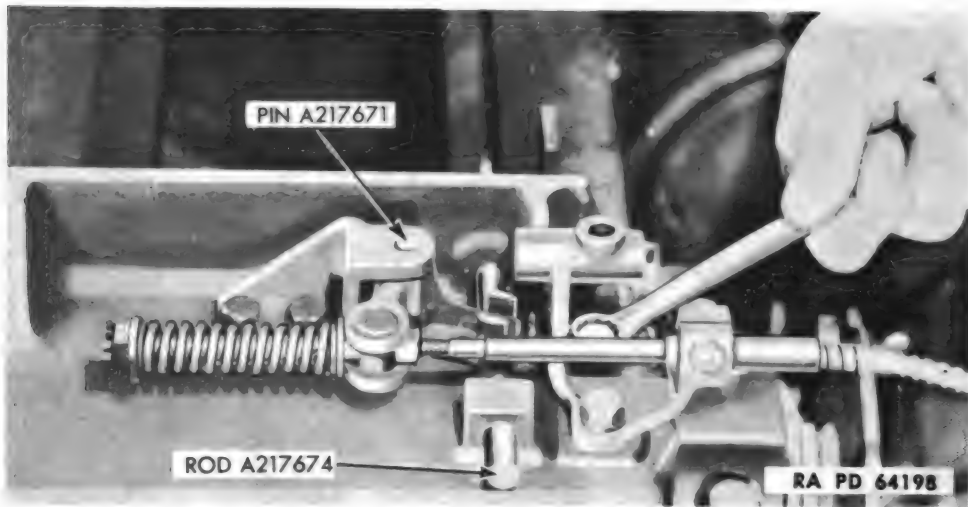


Figure 61—Removing Foot Firing Mechanism Cable from Cradle

(2) **M3E1 CARRIAGE.** The firing mechanism for the 37-mm gun is the same as that on the M3 Carriage. The firing mechanism for the two cal. .50 machine guns consists of a foot treadle assembly bolted to the lower portion of the elevating mechanism gear case. This foot treadle is operated by the right foot of the elevating operator. Two cables run from this treadle, one to each of the two cal. .50 guns, and are connected to the trigger mechanism.

b. Inspection and Adjustment.

(1) **FOOT FIRING MECHANISM DOES NOT HAVE SUFFICIENT TRAVEL TO FIRE THE GUN.** This is usually caused by a bent trigger bar. If it is

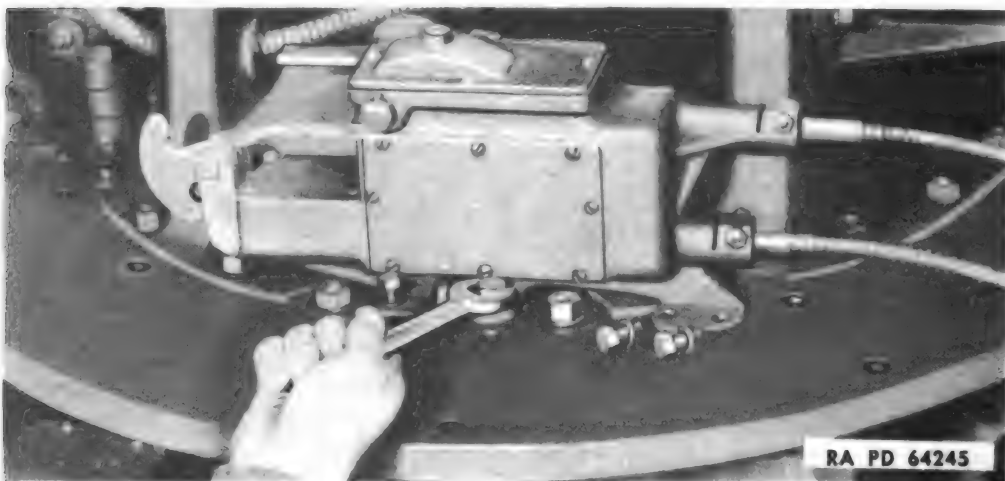
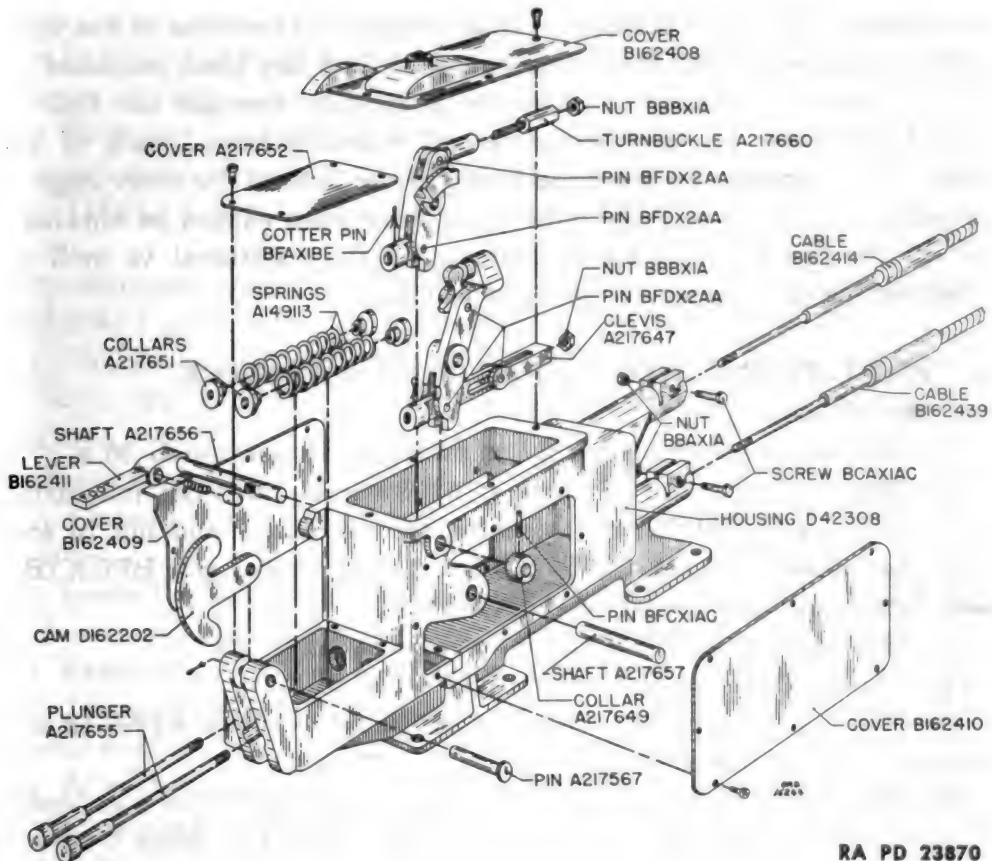


Figure 62—Removing Foot Firing Mechanism

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Figure 63—Foot Firing Mechanism—Exploded View

necessary to change the gun, replacing it with a gun other than the one issued in the mount, it will be necessary to adjust the travel of the foot firing mechanism to the trigger of the new gun. This adjustment can be made by backing off nut BBFX1E on the vertical shaft of the foot firing mechanism to the trigger of the new gun. After the linkage has been adjusted so the gun will fire, the foot firing pedal must be checked to see that the pedal lock does not lock the pedal in firing position. If this should occur, it will be necessary to build up with welding metal the link of the foot firing mechanism, which bears against the trigger bar, until a proper adjustment is possible.

(2) **FOOT FIRING PEDAL LOCK STICKS AND IS HARD TO DISENGAGE.** The clearance between the latch pin and its socket is rather close in a new mount. If not well lubricated, the pin may bind and be very hard to disengage. In extreme cases, or if the rod has been permitted to rust while the mount was in transit, it may be necessary to work the rod down with abrasive cloth. Clean and lubricate as specified in paragraph 58.

(3) **EXCESSIVE PLAY IN THE FOOT FIRING PEDAL.** It may be possible to depress the firing pedal C53755 so that the plunger A147311 catches

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under its seat behind pedal C53756. This, in effect, locks the firing mechanism in the open position so that the gun will continue to fire until the ammunition is exhausted. The pedal C53756 has been modified on materiel under production, so that the protrusion beneath the hole in which the plunger fits has been increased in length from 1 inch to 1½ inches. This dimension is from the center of the hole to the outer edge of the protrusion. If a new pedal with these dimensions cannot be obtained, the old one can be modified by building up the additional ½ inch required on the protrusion, by means of welding.

38. FOOT FIRING MECHANISM, M3A1 CARRIAGE.**a. Removal.**

(1) Remove platform assembly as described in paragraph 36 a.

(2) Remove front end of cable B162439 from the front foot firing cable pedal, right C54573, by loosening the cap screw and nut in foot firing mechanism bracket C54572. Then tap out taper pin BFCX1BB from foot firing cable pedal screw A149119.

(3) Use offset screwdriver and remove screw A149119.

(4) Loosen clevis nut with a 7/16-inch wrench.

(5) Remove the screw in cable bracket; unscrew clevis A149116 and slide cable out of bracket.

(6) Disconnect the foot firing mechanism long cable from gun cradle by removing two cap screws and lock washers from foot firing trunnion cable bracket, and the foot firing cam plunger bracket, using a 9/16-inch wrench. Withdraw the foot firing trunnion rod A217674 from bracket.

(7) Remove the four cap screws, nuts and washers securing the foot firing mechanism housing to top carriage and lift off mechanism and cables.

b. Disassembly.

(1) Remove foot firing housing covers: rear A217652, top B162408, left side B162409, and right side B162410 by removing the retaining screws.

(2) Remove cap screws BCAX1AC and nuts BBAX1A from housing cable leads.

(3) Loosen lock nuts BBBX1A on both foot firing cables from within housing D42308.

(4) Unscrew cables from foot firing mechanism turnbuckle A217660 and clevis A217647. Cable B162414 is removed from the turnbuckle and cable B162439 from clevis.

(5) Remove cotter pin BFAX1CD and pin A217567, and remove rear pedal cam B162202.

(6) Remove rear pedal cam plungers A217655 by withdrawing cotter pins BFAX1BE and unscrewing plungers from lever assemblies.

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(7) Remove two rear pedal cam plunger springs A149113 and the two rear pedal cam plunger spring collars A217651 from each spring.

(8) Drive out taper pin BFCX1AC and remove foot firing mechanism change lever shaft collar A217649.

(9) Withdraw foot firing mechanism change lever B162411 and foot firing mechanism change lever shaft A217656 as an assembly.

CAUTION: Catch the small plunger and spring that are retained by the lever.

(10) Remove shaft A217567 on which lever assemblies B162413 and B162412 pivot in the housing. Then lift out lever assemblies.

(11) Remove pawl A217654, stop A217659, and spring A217693 from lever B162412 by tapping out the two pins BFAX1BA and BFDX2AA.

c. Inspection.

(1) Thoroughly clean all parts and the interior of housing before inspection.

(2) Inspect all parts for wear and burs, especially the pawl and dog, since these parts control the single-fire action of the firing mechanism.

(3) Examine all springs for collapse and replace all worn parts.

(4) Thoroughly lubricate all internal parts with GREASE, O. D. (seasonal grade).

(5) After assembly and installation, check action of mechanism. When pedals are depressed the gun fires. When foot pressure is removed the mechanism should spring back into initial position and pedals should lock.

(6) Measure clearance between foot firing trunnion rod and foot firing trunnion arm. With mechanism at rest the clearance should be $\frac{1}{16}$ inch.

d. Assembly.

(1) Install the four pedal cam plunger spring collars A217651 in housing and slip the cam plunger springs A149113 in place.

(2) Install stop A217659 and spring A217693 in foot firing mechanism with retaining pin BFAX1BA. Then install the pawl A217654 and insert pivot pin BFDX2AA.

(3) Place lever assembly in housing and insert plunger A217655 through plunger spring and screw into clevis of lever until cotter pin holes aline. Secure with cotter pin BFAX1BE.

(4) Press shaft A217657 through lever from outside of housing so it will hold lever in place. Then install rear pedal cam plunger lever assembly B162413 in position parallel with the foot firing mechanism lever and press the shaft through both lever assemblies and housing.

(5) Place the remaining cam plunger through the spring and screw into cam plunger lever assembly. Aline holes and secure with cotter pin.

(6) Place foot firing mechanism change lever B162411 through upper

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Figure 64—Tightening Cable Bracket Screw

holes of housing and install spring and plunger in recess in lever. Place collar A217649 on other end of shaft and secure with taper pin BFCX1AC.

(7) Install long cable B162414 in upper cable lead of housing and screw threaded end into turnbuckle. Tighten lock nut BBBX1A. Replace cable clamp screw and tighten nut, locking cable in housing.

(8) Install short cable B162439 in lower opening of housing and thread into clevis of foot firing mechanism lever. Tighten lock nut, replace cable clamp screw, and tighten nut locking cable in housing.

NOTE: The threaded end of cable should screw into clevis only $\frac{1}{2}$ inch, or cable end may prevent positive action of mechanism in single fire position.

(9) Place rear pedal cam B162202 in position and install pin A217567 and cotter pin.

(10) Install all four covers.

e. Installation.

(1) Insert foot firing mechanism cable (short) B162439 through foot firing mechanism bracket; install clevis and thread onto cable end.

(2) Attach clevis to foot firing pedal by inserting screw A149119 through clevis and thread into foot pedal.

NOTE: Do not install taper pin in this assembly or tighten clevis lock nut until cable length has been adjusted.

(3) Tighten screw in cable bracket C54572, making certain that slot in cable is aligned with screw.

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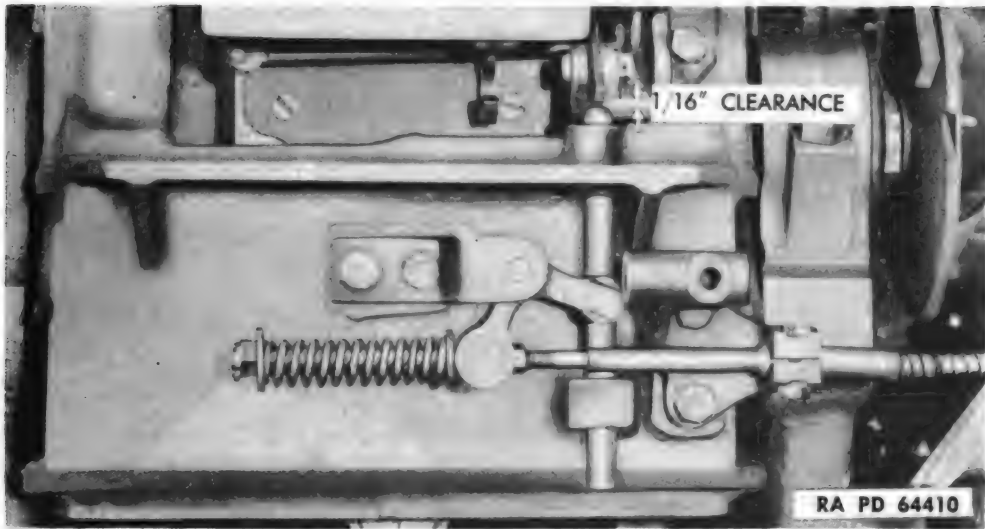


Figure 65—Adjustment of Foot Firing Trunnion Rod

- (4) Connect foot firing mechanism cable (long) B162414 to gun cradle by installing the foot firing trunnion cable bracket and foot firing trunnion cam bracket and bolting them to cradle.
- (5) Install foot firing trunnion rod A217674 through rear end of



Figure 66—Adjusting Foot Firing Mechanism Cable



Figure 67—Adjusting Foot Firing Cable Pedal—Front

bracket with rounded end of rod toward trunnion arm and cable plunger arm engaged in slot of rod.

(6) Replace platform assembly and install the 14 cap screws, lock washers, and nuts, securing top carriage brackets to top carriage.

f. Adjustment.

(1) Adjust foot firing trunnion rod by changing position of nut BBDX1A so a clearance of $\frac{1}{16}$ inch exists between rod and foot firing trunnion arm.

(2) Adjust length of foot firing mechanism cable B162439 at foot firing cable pedal by removing screw A149119 and adjusting clevis A149116 to permit firing by depression of front and rear foot pedal.

(3) Replace screw A149119 and secure with taper pin BFCX1BB; tighten clevis lock nut.

NOTE: If additional adjustment is required, check the travel of front and rear foot pedals.

(4) Adjust the travel of front pedal by turning a stop screw located on front of foot firing cable bracket to secure proper setting.

(5) To adjust travel of rear pedal turn stop screw located beneath rear platform.

NOTE: If still unable to secure proper action of foot firing mechanism in single fire, remove top cover of foot firing mechanism housing and after backing off lock nuts, lengthen or shorten cables by moving threaded end of cable in turnbuckle for long cable, or threaded end of cable in clevis for short cable.

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Figure 68—Adjusting Foot Firing Cable Pedal—Rear

39. HYDRAULIC GEAR SWITCH ASSEMBLY.

a. Removal.

(1) Remove cotter pin from hydraulic gear switch rod and remove pin from rod B162177 at azimuth switch yoke connection.

(2) Remove cotter pin, washers, and connecting pin from hydraulic gear switch rod eye A149083 which connects hydraulic gear switch spring rod B162178 to azimuth clutch lever.

(3) Remove three bolts, nuts, and lock washers securing hydraulic gear switch bracket D42239 to top carriage, using a $\frac{9}{16}$ -inch box wrench on bolt and a $\frac{5}{8}$ -inch wrench on the nut.

b. Disassembly.

(1) Disconnect hydraulic gear switch rod B162177 from outer crank B162173 by removing cotter pin and clevis pin.

(2) Back off nut and remove yoke EEAX1D from hydraulic gear switch rod.

(3) Remove outer crank from hydraulic gear switch shaft B162175 by tapping out taper pin BFCX1BC. Drive against small end of pin, on under side of outer crank.

(4) Remove fulcrum B162179 from hydraulic gear switch inner crank B162174 by removing cotter pin, nut, and washer. Tap out taper pin and remove inner crank.

(5) Unscrew hydraulic rod eye from hydraulic gear switch spring rod B162178 and remove two nuts from rod, removing hydraulic gear switch short spring B149076 from spring rod. Slide fulcrum and long spring off rod and remove two end nuts.

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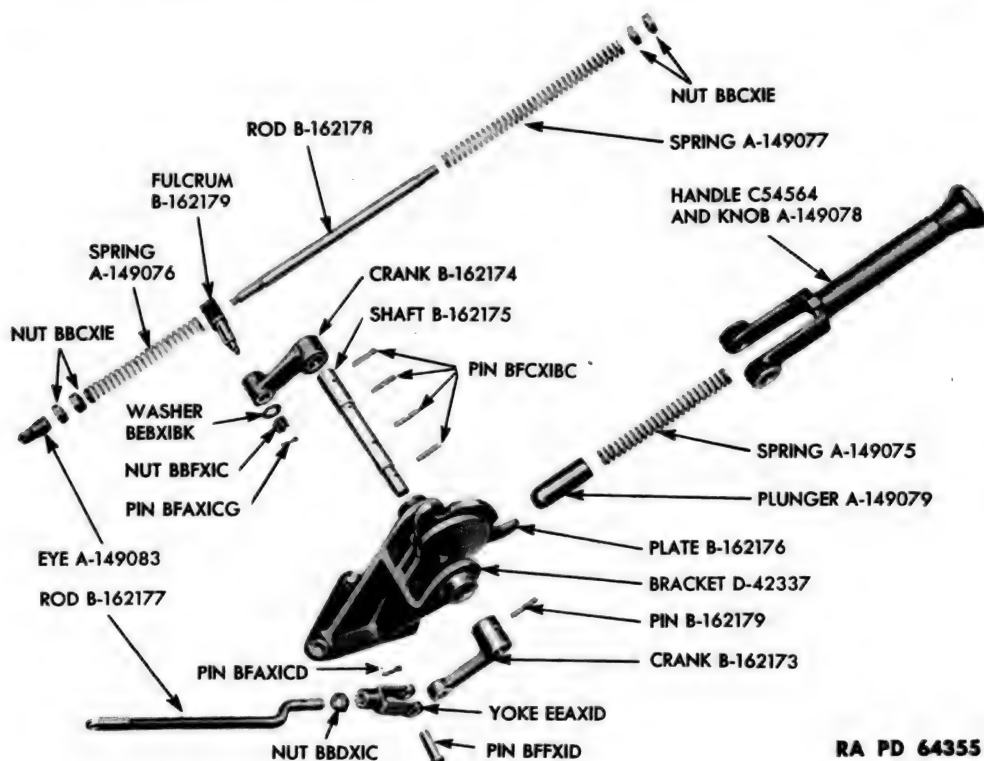


Figure 69—Hydraulic Gear Switch Assembly—Exploded View

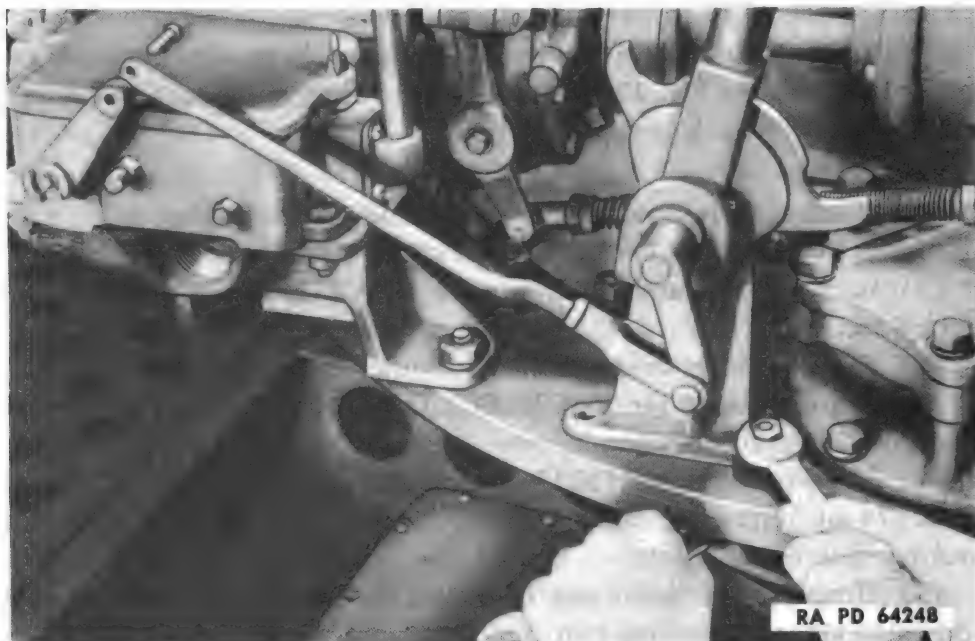


Figure 70—Removing Hydraulic Gear Switch Assembly

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(6) Tap out two taper pins which secure hydraulic gear switch handle C54564 to hydraulic gear shift shaft, and withdraw shaft from bracket, taking care to catch plunger and spring located in recess of handle, as handle is removed.

c. Inspection.

- (1) Clean and lubricate all parts thoroughly before assembly.
- (2) Install new cotter pins throughout.
- (3) Check springs for tension and "set."
- (4) Check shafts, cranks, pins, and plunger for wear. Replace any worn parts.

d. Assembly.

- (1) Install spring A149075 and plunger A149079 in recess of handle C54564 and fit handle to bracket D42237, lining up holes in bracket and handle.
- (2) Install shaft B162175 through bracket and handle, and secure by inserting two taper pins with drift.
- (3) Install inner crank B162174 and outer crank B162173 by inserting taper pin in each crank, using drift.
- (4) Install light adjustable rod end yoke on outer crank, securing with pin BFFX1D and cotter pin.
- (5) Screw nut BBDX1C on to hydraulic gear switch rod, and secure rod into adjustable rod end light yoke, tightening nut against yoke.
- (6) Install fulcrum B162179 in inner crank, securing with washer nut and cotter pin.
- (7) Install hydraulic gear switch spring rod through fulcrum, and install short spring on rear end of rod, and long spring on front end of rod, screwing on two nuts on front end of spring rod, securing short spring to rod, and screwing on two nuts and rod eye on rear end of spring rod, securing long spring to rod.

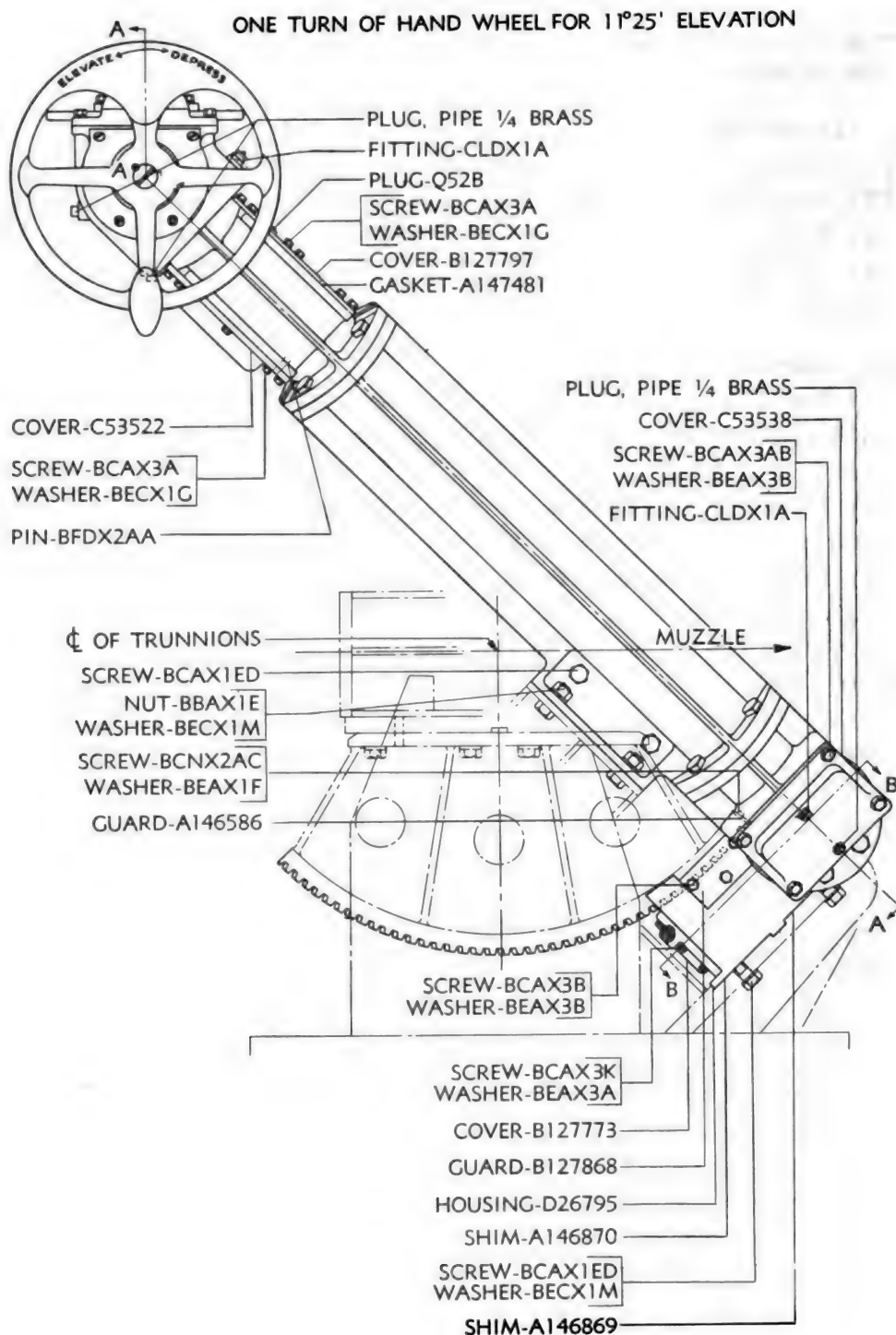
e. Installation.

- (1) Position hydraulic gear switch mechanism on carriage and secure hydraulic gear switch rod eye to azimuth clutch lever by inserting clevis pin through rod eye and securing with washer and cotter pin.
- (2) Secure hydraulic gear switch rod to azimuth switch yoke by installing pin and cotter pin.
- (3) Install hydraulic gear switch mechanism bracket to top carriage installing three bolts, nuts, and lock washers, using a $\frac{9}{16}$ -inch wrench.

40. ELEVATING MECHANISM, M3 AND M3E1 CARRIAGES.

a. **Replacement of Parts.** Backlash of over one-quarter turn of the handwheels, chattering gears, binding of the mechanism, or failure to elevate will indicate necessity for repair or replacement of parts.

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Figure 71—Elevating Gear Case Assembly, M3 and M3E1 Carriages

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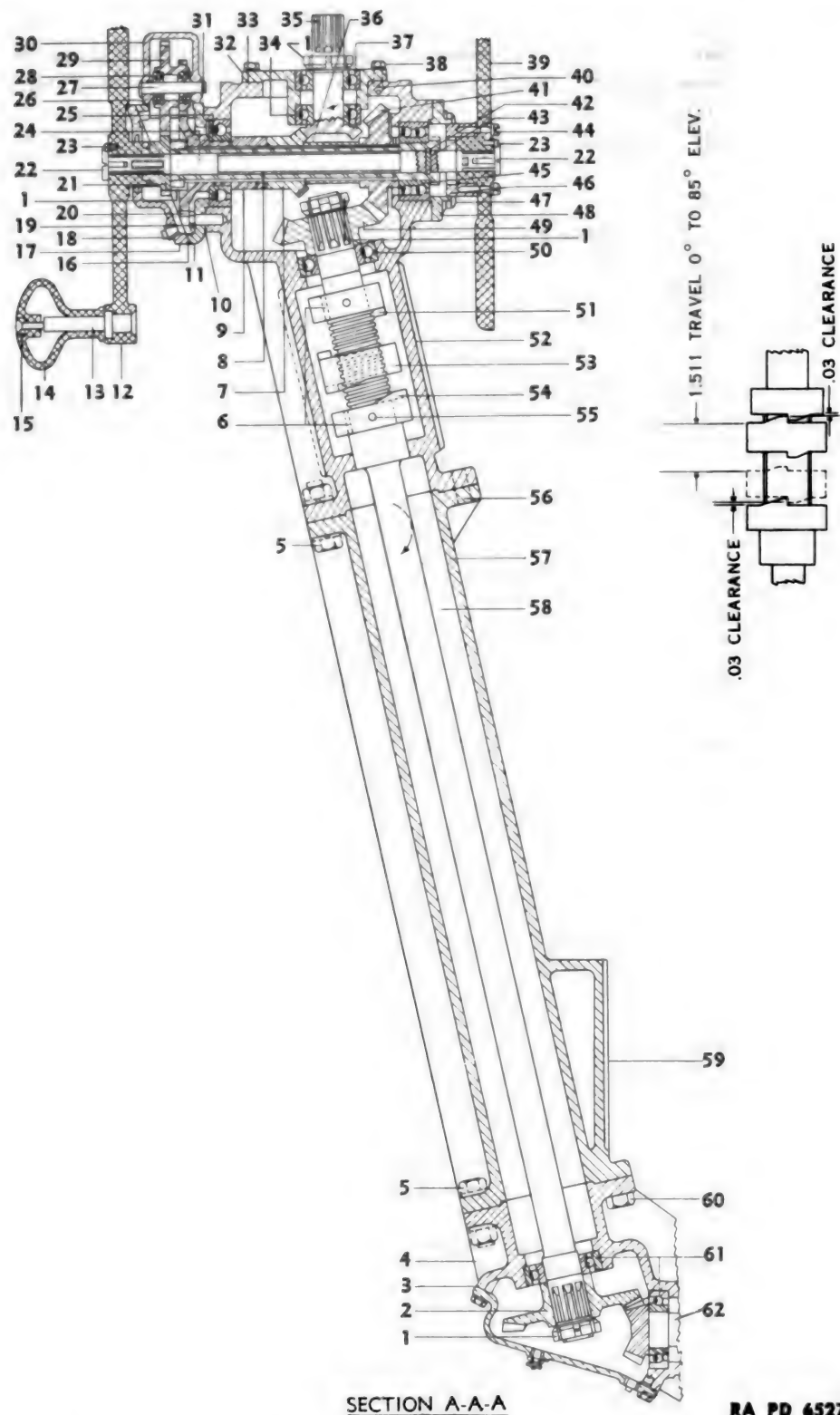
h. Disassembly. Remove the gun and cradle from the carriage and disassemble in the following manner:

Part	Means of Support	Method of Removal
Case C53684, case D26907, brackets D26908 and C53639, and enclosed parts.	Four screws BCAX1ED, nuts BBAX1E, and washers BECX1M and four screws BCAX1EC and washers.	Remove screws, nuts, and washers and lift assembly to a convenient place to permit disassembly.
Cover B160237, with gear B160220 and bearings A146723 and A146725.	Four screws BCAX1CA and washers BECX1K.	Remove screws and washers.
Gear B160220.	Nut BBRX1AF and washer.	Unscrew nut and drive out.
Bearings A146723 and A146725.	Forced in cover B160237.	Force out, using equal pressure all around the bearing.

The balance of the upper portion of this gear case will be disassembled in the same manner as the traversing gear case (par. 42).

Gear B160235.	Splined to shaft.	Pull from the shaft.
Cover B127797.	Six screws BCAX3A and washers BECX1G.	Remove screws and washers.
Cover C53522.	Six screws BCAX3A and washers BECX1G.	Remove screws and washers.
Case D26907, stops B127795 and B127796, and dog B127794.	Four screws BCAX1EF, nuts BBAX1E and washers BECX1M, taper pins BFCX1FK, and keys A20239.	Drive out taper pins from stops; spin the dog to its maximum height; remove screws, nuts, and washers from case; raise case high enough to force stops off keys; remove upper key and spin dog off threaded portion of shaft and lift case free of shaft picking off stops and dog.
Bearing A146724.	Forced in case D26907.	Force out, using equal pressure all around the bearing.
Bracket D26908.	One screw BCAX1ED, four nuts BBAX1E and washer BECX1M, and three screws BCAX1EF, nuts BBAX1E, washers BECX1M.	Remove screws, nuts, and washers and lift bracket off, up over shaft.
Cover C53538.	Four screws BCAX3AB and washers BEAX3B.	Remove screws and washers.
Guard A146586.	Two screws BCNX2AC and washers BEAX1F.	Remove screws and washers.

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SECTION A-A-A

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Figure 72—Elevating Gear Case Section, M3 and M3E1 Carriages

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- | | |
|----------------------|----------------------|
| 1—Nut BBRX1AF | 30—Case B160316 |
| 1—Washer BEFX1AF | 30—Screw BCAX1CA |
| 2—Gear B160233 | 30—Washer BEAX1L |
| 3—Gasket B127897 | 30—Fitting CLDX1A |
| 4—Case C53639 | 30—Pin BFDX2AA |
| 5—Screw BCAX1EF | 31—Pin BFAX1BE |
| 5—Washer BECX1M | 32—Cover B160237 |
| 5—Nut BBAX1E | 33—Shim B127846 |
| 6—Key A20239 | 34—Bearing A146725 |
| 7—Gear B160236 | 35—Gear B160220 |
| 8—Shaft B160309 | 36—Spacer A146726 |
| 9—Spacer A147131 | 37—Bearing A146723 |
| 10—Gasket A147141 | 38—Screw BCAX1CA |
| 11—Case C53684 | 38—Washer BECX1K |
| 11—Plug Q52A | 39—Handwheel C53515A |
| 12—Handwheel C53515A | 40—Pin BFDX2BB |
| 13—Spindle A26256 | 41—Gear B160234 |
| 14—Knob A11644 | 42—Ball CCAX1B |
| 15—Washer A26257 | 43—Spring FAAX1C |
| 16—Gasket A147140 | 44—Screw A147132 |
| 17—Cover B160315 | 44—Washer BEAX1H |
| 17—Screw BCKX2CF | 45—Bearing A146556 |
| 17—Screw BCFX2DG | 46—Gear B160313 |
| 17—Washer BECX1G | 47—Screw BCFX2FK |
| 18—Plug Q52A | 47—Washer BECX1K |
| 19—Screw A147139 | 48—Cover B160307 |
| 19—Washer BEAX1L | 49—Gear B160235 |
| 20—Gear B160317 | 50—Bearing A146724 |
| 21—Gear B160310 | 51—Stop B127795 |
| 22—Screw A147133 | 52—Case D26907 |
| 23—Screw BCFX2BB | 53—Dog B127794 |
| 24—Shaft B160311 | 54—Stop B127796 |
| 25—Bearing A147134 | 55—Pin BFCX1FK |
| 26—Shim A147137 | 56—Pin BFDX2CC |
| 27—Shaft A147136 | 57—Bracket D26908 |
| 28—Bearing A147135 | 58—Shaft C53646 |
| 29—Gear B160314 | 59—Shim A146867 |
| | 60—Screw BCAX1ED |
| | 61—Bearing A146715 |
| | 62—Shaft B160232 |

Legend for Figure 72—Elevating Gear Case Section, M3 and M3E1 Carriages

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Part	Means of Support	Method of Removal
Shaft C53646 and gear B160233.	Nut BBRX1AF.	Remove nut BBRX1AF and washer. Drive shaft up, out of gear and bearing, catching gear as shaft is driven out.
Stud A146713.	Screwed in shaft B160232 and locked with screw BCFX2AC.	Remove lock screw and unscrew.
Gear B160231.	Splined to shaft B160232.	Pull from the shaft.
Shaft B160232.	Secured in case C53639.	Drive out.
Bearings A146715.	Forced in case C53639.	Force out, using equal pressure all around the bearing.
Worm housing D26795, and enclosed worm B127646, shaft B160223, and gear B160230.	Four screws BCAX1ED and washers BECX1M.	Cradle must either be removed or raised sufficiently high to have elevating rack clear worm. Remove screws and washers.
Cover B160222.	Four screws BCAX3A and washers BEAX3A.	Remove screws and washers.
Cover B127773.	Six screws BCAX3K and washers BEAX3A.	Remove screws and washers.
Nut A147064.	Screwed on shaft B160223 and locked with washer BEFX1AG.	Straighten prong of lock washer, unscrew nut, and remove lock washer.
Shaft B160223 with gear B160230.	Splined to worm B127646 and secured in bearing A146790.	Drive out in direction of gear and pick worm and spacer out of housing.
Gear B160230 and bearing A146790.	Nut A147063 and cotter pin, splined and forced to shaft B160223.	Remove cotter pin and nut. Pull gear from shaft.
Outer cones of bearings A146790.	Forced in housing D26795.	Force out, using equal pressure all around the cone.

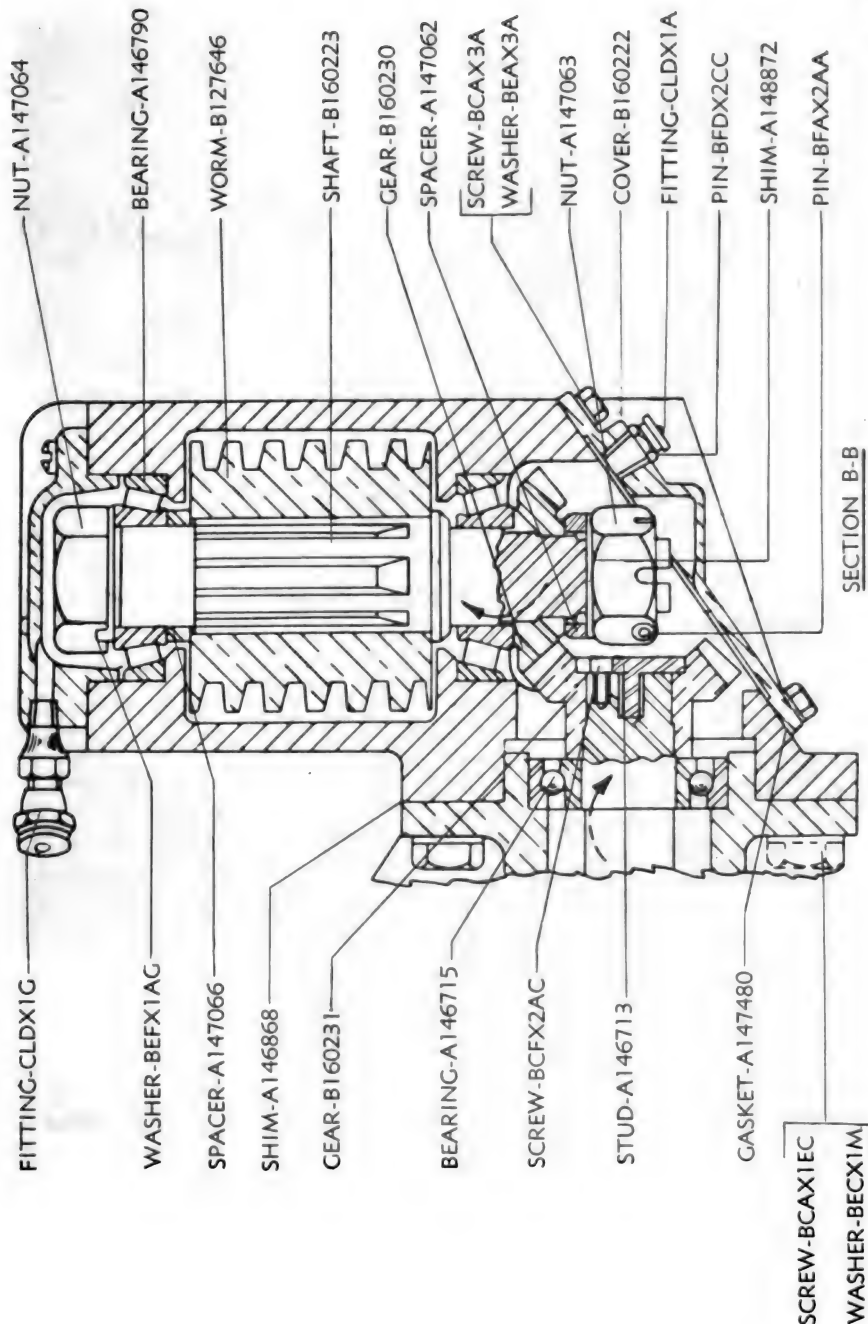
c. Assembly.

(1) Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when a shaft is put through them, the carriage will not be displaced.

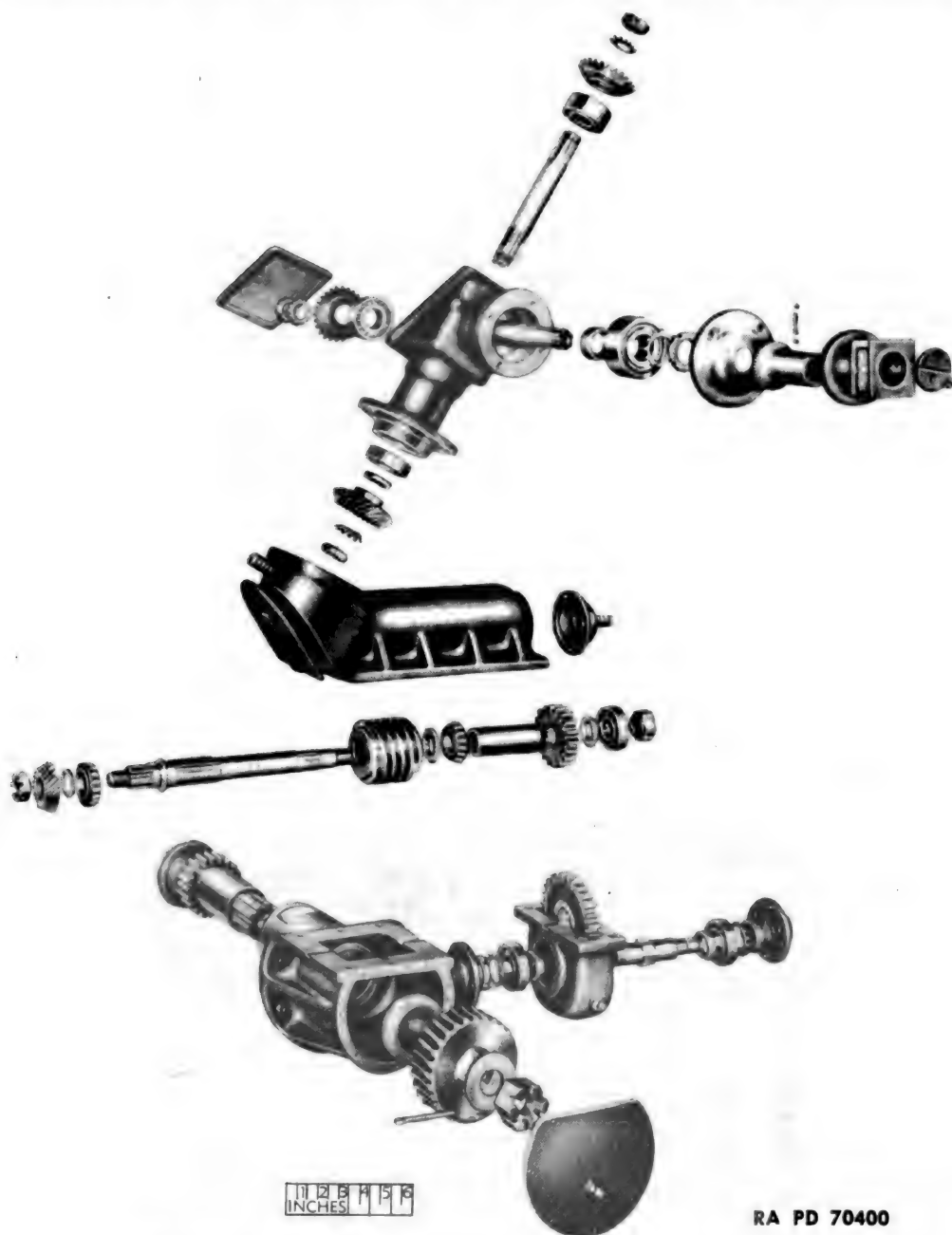
(2) Stops B127795 and B127796 and dog B127794 must be placed in position on the shaft C53646 at the same time that the assembled gear case D26907 is put into position. Secure the stops to the shaft by means of the taper pins and keys in one of the keyways of each stop. Rotate the dog to its lowest position on the shaft. Assemble cover C53522 to the case so that the stud of the dog will fit into the socket in the

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NOTE: Parts are labeled in breakdown illustrations in following pages.

Figure 74—Elevating Mechanism, M3A1 Carriage—Exploded View

cover. Replace the cradle temporarily on the carriage at a 0-degree elevation. Operate the elevating mechanism to check the operation of the dog and stops with relation to the movement of the cradle. Adjustment is possible by removing cover C53522 and turning the dog on the shaft, or by using a different keyway in one or both of the stops. It may be found necessary to cut new holes in the shaft for the taper pins that

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Figure 75—Removing Hand Crank

pass through the stops. Before replacing the cradle, set the dog in its lowest position and then put the cradle on the carriage at a 0-degree elevation. The dog can then rise through its maximum range when the cradle is elevated to 85 degrees. When the stop mechanism is properly adjusted, the covers should be replaced and the cradle secured at the trunnions.

41. ELEVATING MECHANISM, M3A1 CARRIAGE.

a. Removal.

(1) Gun and cradle must be removed from upper carriage before elevating mechanism can be removed.

(2) Remove hand crank C87039 by pulling out hand crank plunger and lifting crank from gear sleeve.

(3) Disconnect hydraulic oil gear assembly at the base by removing

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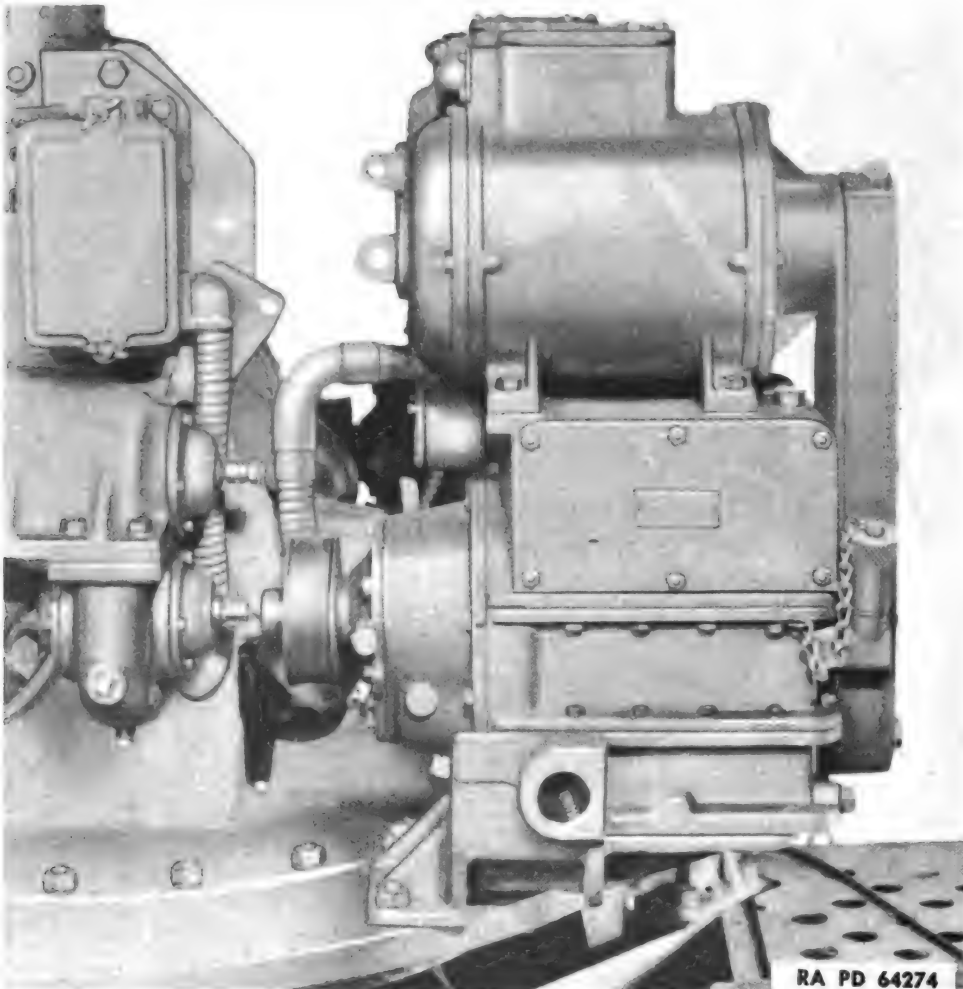


Figure 76—Separating Oil Gears and Elevating Mechanism



Figure 77—Removing Two Bolts from Upper Housing

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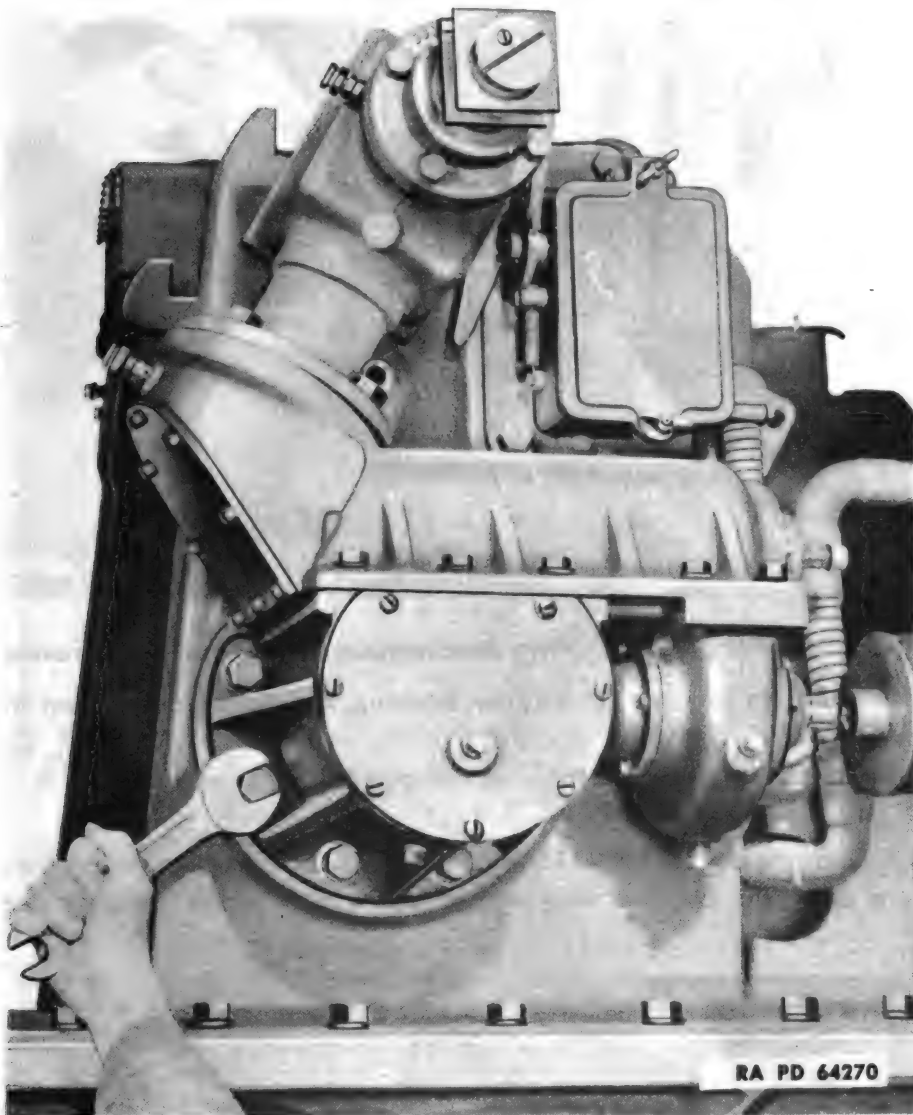


Figure 78—Removing Bolts from Lower Housing

four cap screws. Remove the nuts from the brace at the top and slide the oil gear assembly straight away from the elevating mechanism to disconnect the hydraulic drive coupling from the splined power drive shaft B162210 of the elevating mechanism. Note location and number of shims beneath the oil gear base so they may be replaced properly.

(4) Remove two bolts from upper housing, taking care not to lose the shim which is held in place by these bolts.

(5) Remove six bolts from lower housing, using a $\frac{3}{4}$ -inch wrench.

(6) Scrape paint from portion of lower gear housing extending through trunnion frame of top carriage to facilitate sliding the mechanism away from the carriage.

(7) Insert wood blocks on inner side of pinion housing and, using

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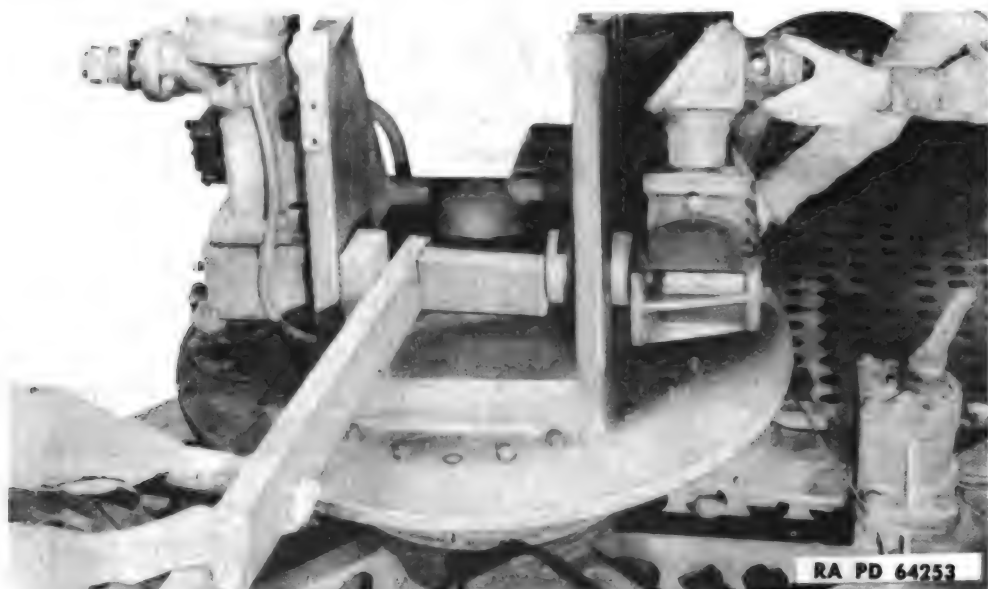


Figure 79—Forcing Elevating Mechanism from Trunnion Frame

wooden beam for leverage, force gear, housing, and entire mechanism from top carriage.

(8) Support the mechanism and remove from top carriage.

b. Disassembly.

(1) Remove cover B162218 which is held by eight screws and separate the assembly by removing four screws which fasten the gear sleeve



Figure 80—Removing Elevating Mechanism

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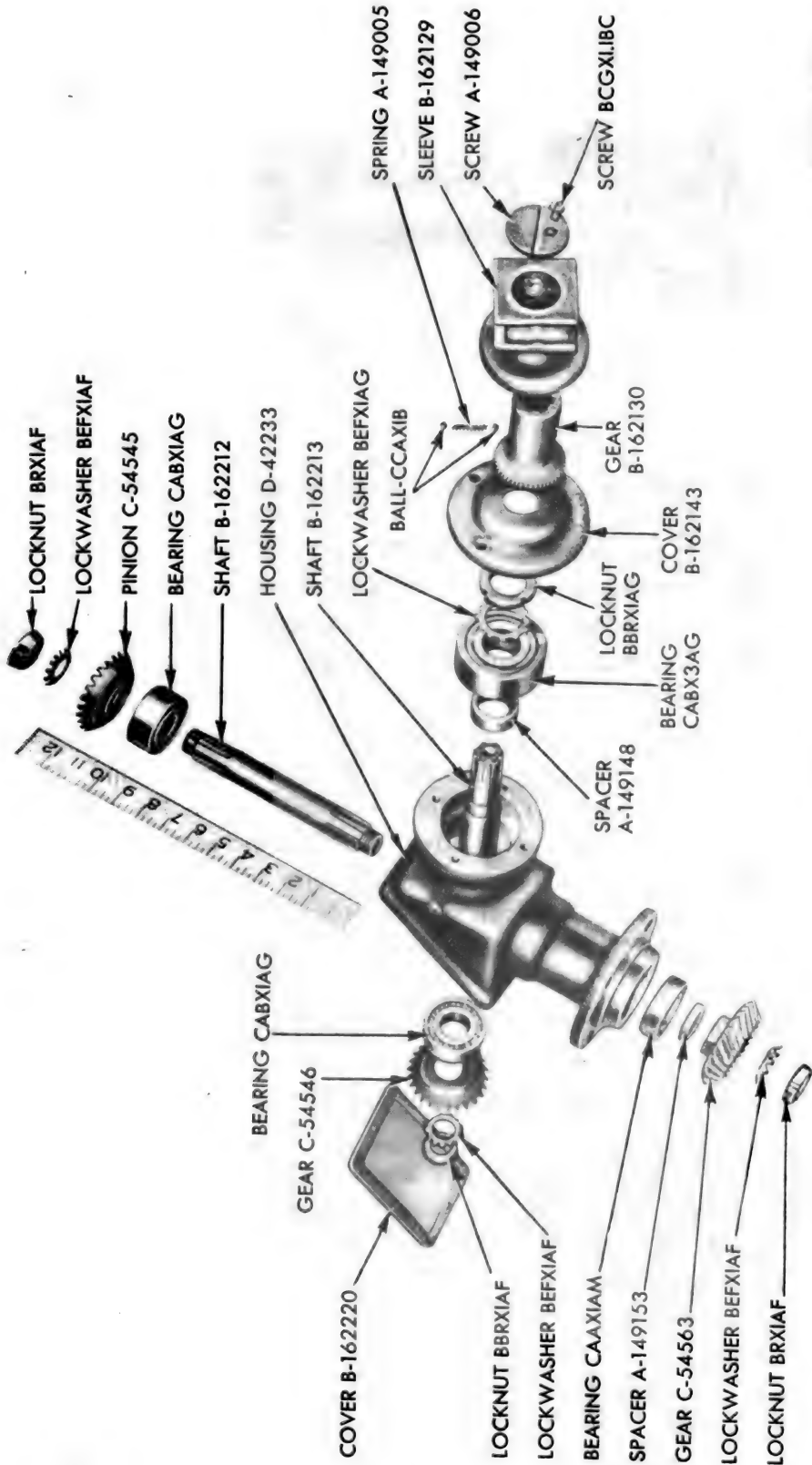


Figure 81—Elevating Mechanism Upper Assembly—Exploded View

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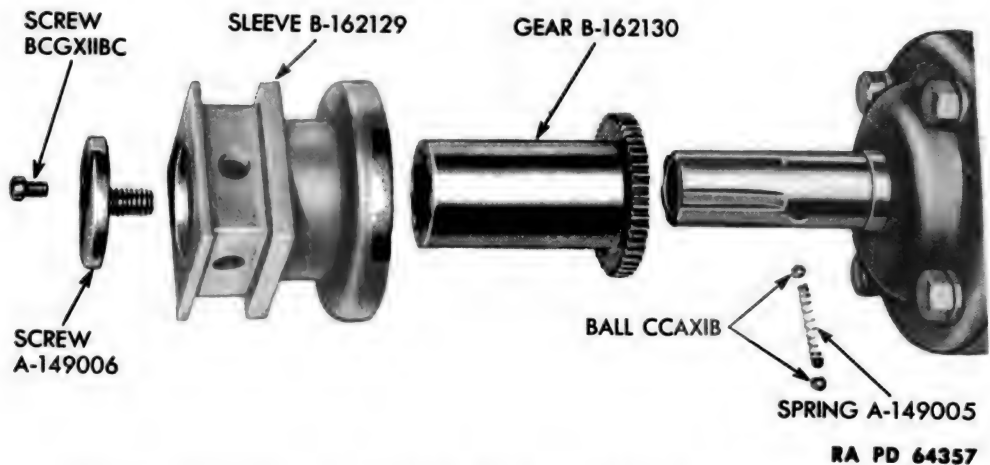


Figure 82—Hand Crankshaft Assembly—Exploded View

housing D42233 to worm gear housing D42232. Lift sleeve housing away from worm gear housing, disengaging the gear from the pinion.

(2) Take out screw BCGX1.1BC and screw A149006 and slide sleeve from gear, holding hand around inner end of sleeve in such a manner that balls CCAX1B and spring A149005 will be caught if wear has taken place to such an extent that balls may pop out of gear.

(3) Before removing gear B162130, balls CCAX1B and spring A149005 must be removed. The balls are held in the holes in gear by slightly closing the hole in the gear after assembly; therefore, with a small drift pin, punch, or round file, the hole in one side of gear must be enlarged to allow the ball to drop out. Rotate the gear one-half revolution, which will permit the spring and other ball to drop out and the gear to be removed.

(4) Remove screws and washers from cover B162143 of the assembly housing D42233, and remove cover.

(5) Remove eight screws and washers from cover B162220 on opposite end of housing and remove cover.

(6) Remove lock nuts BBRX1AF and BBRX1AG and the two lock washers from shaft B162213 and, with a support under inner race of outer bearing CABX3AG, press on gear end of shaft to remove gear C54546. After gear is removed, the bearings and shaft assembly can usually be removed from the housing by hand.

CAUTION: In removing gears, bearings, and shafts, tap lightly with wood or soft metal drift and mallet. If part does not loosen with this procedure, use arbor press. Always apply force to inner race of bearing to remove from shaft, and to outer race of bearing when removing bearing from housing.

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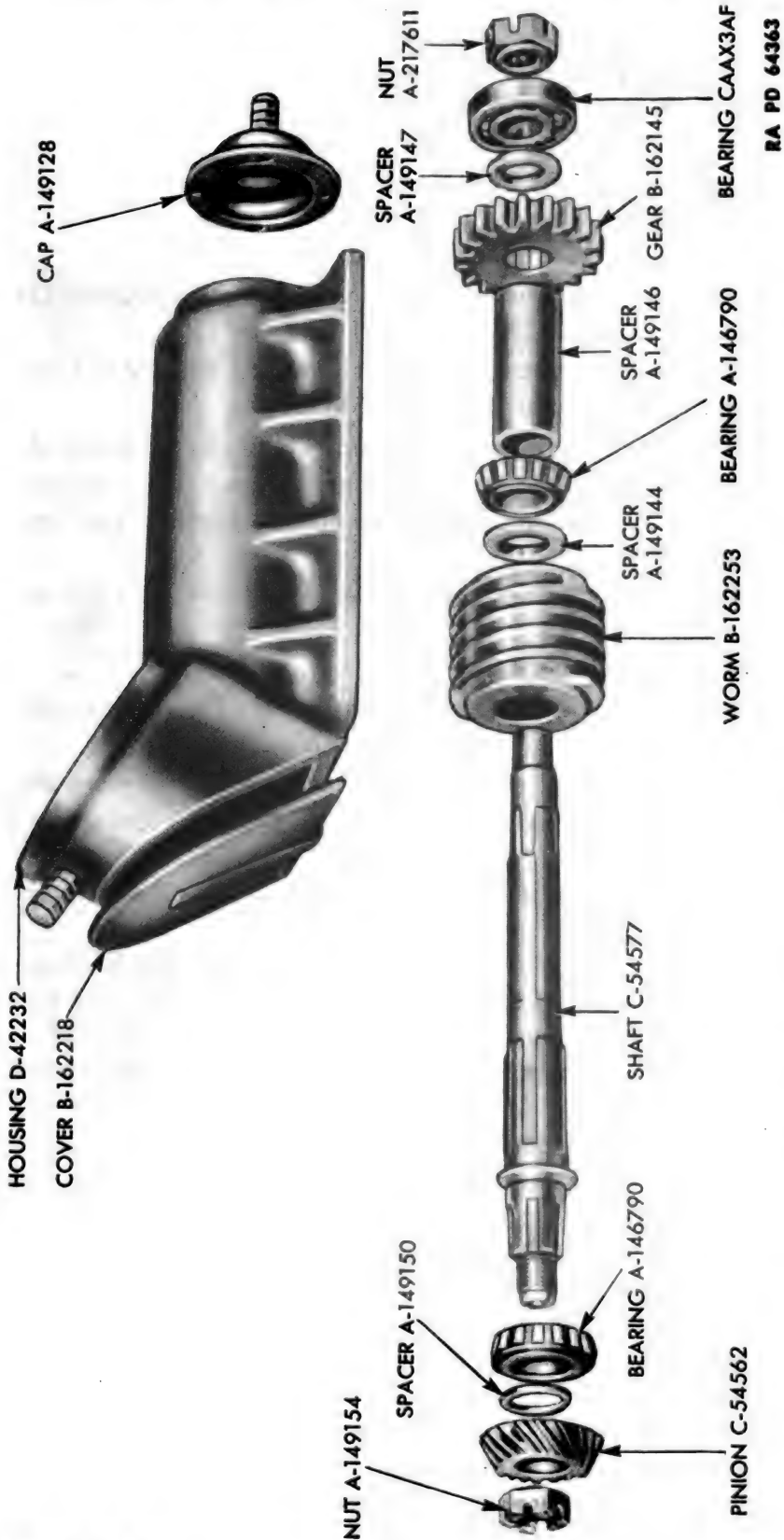


Figure 83—Elevating Mechanism Worm Assembly—Exploded View

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(7) Remove nut BBRX1AF and lock washer from intermediate shaft, which holds pinion C54545 on shaft B162212. Apply pressure to upper end of shaft and press through gear and out of housing. The lower bearing CAAX1AM usually will be removed with the shaft. Remove bearing CABX1AG from housing by tapping lightly.

(8) Remove lock nut BBRX1AF and lock washer from lower end of shaft and press shaft out of gear C54563. Remove spacer and bearing from shaft.

(9) Remove six screws which fasten worm gear housing D42232 to worm wheel housing D42231.

(10) Remove four screws which fasten worm housing to the elevating mechanism hydraulic shaft housing C54542.

CAUTION: Shims are usually present where the hydraulic shaft housing and the worm wheel housing are joined. These shims should be wired in place to prevent loss and secure the correct depth of gear mesh when reassembling.

(11) Remove cotter pin and unscrew nut A149154 from worm gear shaft C54577.

(12) Pull pinion C54562 and spacer from shaft.

(13) Remove worm gear housing cap A149128 at outer end of worm gear housing by taking out four screws and washers.

(14) Take out cotter pin and remove nut A217611 from shaft.

(15) Place a support under end of worm B162253 and apply pressure to the end of shaft C54577 from which nut A217611 was removed. This will remove shaft from bearings and housing and will also remove shaft from worm and spacers.

(16) Force bearings CAAX3AF and A146790 from housing.

(17) Remove cover A149129 and hydraulic shaft housing by removal of four slotted head screws and washers. Remove cap A149025, on opposite side of hydraulic shaft housing, by taking out four slotted head screws and washers.

(18) Remove nuts BBRX1AG and lock washers from both ends of shaft B162210. Press hydraulic drive shaft B162210 out of housing, which will remove hydraulic drive shaft gear B162146.

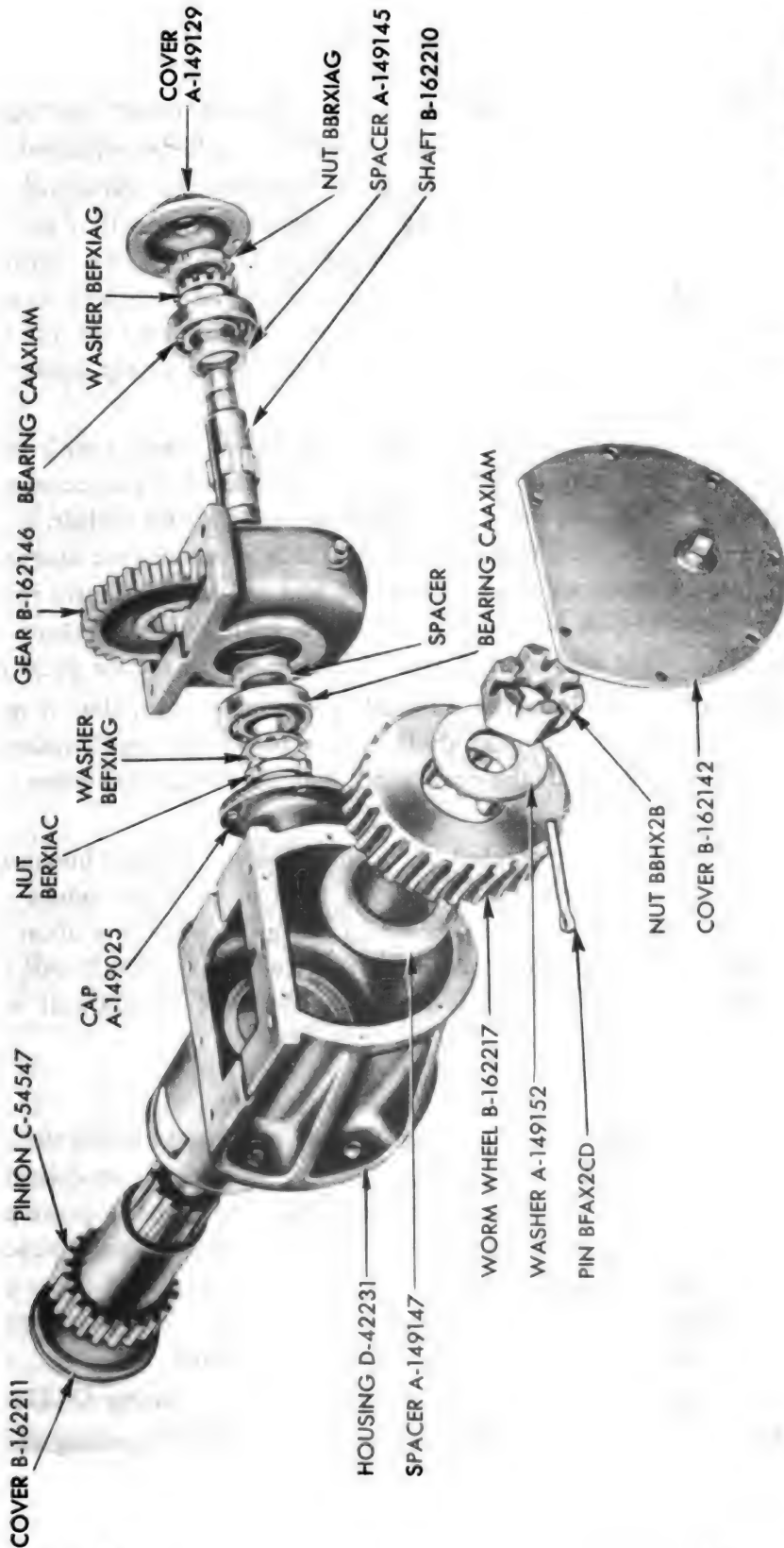
(19) Press bearings CAAX1AM out of housing and remove spacers A149145.

(20) Remove seven screws and washers from the cover B162142 of worm wheel housing D42231 and remove cover.

(21) Unscrew large cover B62211 which is threaded into inner end of worm wheel housing.

(22) Remove cotter pin and nut BBHX2B on outer end of worm wheel pinion. Press pinion from threaded end, thereby removing worm wheel from pinion. Remove spacer and pinion from housing.

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Figure 84—Elevating Mechanism Worm Wheel and Hydraulic Shaft Assemblies—Exploded View

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c. Inspection.

(1) Clean all parts of grease and dirt in SOLVENT, dry-cleaning, before inspection. Ball bearings should be cleaned, oiled, and wrapped in clean paper until installed. Any bearing which feels "rough" or "bumpy" when being rotated slowly under hand pressure should be replaced.

(2) All parts should be given a visual inspection for excessive wear, burs, and high spots denoting binding and end play. Inspection for backlash between gears and between splined parts should be continued throughout assembly of mechanism, replacing parts as necessary to secure an assembled unit which can be operated without bind or backlash. Freedom of operation and absence of backlash is absolutely essential in this unit.

(3) Check hand crank C87039 for proper fit on hand crank sleeve, and remove with file any burs that roughen inside of crank connection. Inspect pressure of spring in hand crank plunger to make certain it gives proper security for holding crank in place. Check internal gear sleeve and gear B162130 for freedom of movement in and out of mesh, and remove any burs or obstruction which may interfere with easy operation. Also note if lash is present and replace part as necessary to secure good fit.

(4) Inspect packing in cover A149129 to make certain that it makes a good seal on the hydraulic gear shaft. If new packing is used, make sure it is expanded into recess in the cover and does not bind shaft when cover is replaced.

(5) Shims have been provided at various points between housings to secure proper mesh of gear teeth without bind or backlash when gears are new. These shims should be replaced in original positions upon reassembly unless backlash in gears indicate that removal of shaft will eliminate backlash and still give freedom of movement throughout entire gear range.

d. Assembly.

NOTE: *All gears are lapped in assembly, so that gears having the same mating numbers and those having match marks should be assembled according to the markings.* This will permit the fitting of the gears properly to obtain the best working point with the least backlash. Absolute cleanliness is essential when reassembling gears, bearings, and other parts of the elevating mechanism, to make sure that no foreign matter is allowed to remain in the unit and cause malfunctioning.

(1) Place worm wheel B162217 into worm wheel housing D42231.

(2) Match splines of pinion C54547 and worm wheel, making certain that splines mate according to punch marks on both pinion and wheel, placing spacer A149127 on inside and washer A149152 on outside of worm wheel.

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(3) Tighten nut BBHX2B on outer end of pinion and secure with cotter pin.

(4) Replace worm wheel housing cover B162142 and secure with seven screws and washers.

(5) Replace worm wheel housing inner cover B162211 by threading into inner end of housing.

(6) Press ball bearings CAAX1AM into hydraulic shaft housing C54542.

(7) Place hydraulic shaft gear B162146 into housing with spacers A149145 on both sides. Press hydraulic shaft through bearings, spacers and gear. Lock with nut and star washer on both ends of shaft.

(8) Replace cap A149025 and cover A149129 to housing and secure each with four screws and washers. Make sure when replacing these parts, that oil filler plug will be on outside when this assembly is bolted to balance of unit.

(9) Replace worm B162253 inside chamber of worm gear housing D42232, and align with worm gear shaft openings through housing.

(10) While holding worm in position, enter short splined end of shaft C54577 into worm and engage large splines of shaft with splines of worm gear. Press shaft into worm until face of worm gear is against shoulder on shaft.

(11) Install bearing and spacer A149150.

(12) Install pinion C54562 and nut A149154 but do not tighten securely.

(13) Install spacer A149144 on the other end of shaft with large diameter of spacer against face of worm.

(14) Install bearing A146790 and spacer A149146.

(15) Install gear B162145 and spacer A149147 with large diameter of spacer against face of gear.

(16) Install bearing CAAX3AF and nut A217611.

(17) Place the housing in a vise and, while holding slotted end of shaft C54577 with a screwdriver, tighten nut A217611 securely to seat all bearings and spacers firmly in their proper positions against each other, and install cotter pin.

(18) There now should be a slight amount of end play in the shaft which can be increased by loosening, or decreased by tightening nut A149154, which will take up clearance between the tapered roller bearings and their recess. Tighten this nut carefully while moving the shaft endwise and rotating it. The nut should be secured with cotter pin at the point where no end play exists and the shaft will rotate freely.

(19) Replace worm gear housing cap A149128 on outer end of housing and tighten screws.

(20) Bolt hydraulic shaft housing and gear assembly to worm

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housing assembly, observing proper placement of shims. Inspect by holding shaft B162210 and check by rotating pinion C54562. There should be no backlash or binding at this point and shims may be selected to secure proper adjustment.

(21) All parts should be assembled into hand elevating mechanism housing D42233 before this subassembly is connected to balance of elevating mechanism.

(22) Press ball bearings CABX1AG on to hand crankshaft B162213. Press both bearing and shaft into upper part of hand crankshaft housing from inner part of housing.

(23) Install spacer A149148 on shaft and press bearing CABX3AG on to outer end of shaft and into housing.

(24) Install lock washer and lock nut BBRX1AG on outer end of shaft but do not tighten securely.

(25) Install gear C54546 and lock with washer and nut BBRX1AF.

(26) Tighten both lock nuts securely.

(27) Install bearing CAAX1AM, spacer A149153, and gear C54563 on the end of intermediate shaft B162212, which has short machined surface near splined end, and assemble lock washer and nut BBRX1AF.

(28) Install top bearing CABX1AG in housing. Hold pinion C54545 in position and press shaft assembly through bearing and into pinion.

(29) Secure both nuts on each end of shaft and when tight, check rotation of shaft for freeness of operation.

(30) Replace both hand crank housing covers.

(31) Install hand crank gear B162130 on shaft B162213 until hole for spring and balls line up in gear and shaft. One hole in the bronze gear should be closed just enough to hold the ball. With this hole on the bottom, drop the spring A149005 in place and insert the other ball CCAX1B. Use a drift pin slightly larger than the drilled hole to close the edge of the hole in by tapping on the drift pin. Close the hole just enough to keep the ball from coming out.

(32) The sleeve B162129 may be pushed over the gear; then replace screw A149006 and lock screw BCGX1.1BC.

(33) Place gasket in position and bolt hand crankshaft housing to upper part of worm housing with four screws and washers.

(34) Install crank and test operation of elevating mechanism by turning hand crank a few rotations, and noting freedom of movement.

(35) Fill elevating mechanism with GREASE, O.D. (seasonal grade).

NOTE: If the oil gear has been removed it should be replaced on its base and wires hooked up, as the terminal boxes are difficult to attach to oil gear when elevating mechanism is in place. Move the oil gear assembly so that coupling will not interfere with hydraulic shaft when elevating mechanism is installed.

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e. Installation.

(1) See that all conduits are in their proper positions; lift elevating mechanism and insert lower end of worm wheel housing through circular opening at lower side of upright member of top carriage. This operation will be easier if light application of oil is used on worm wheel housing.

(2) Bolt worm wheel housing to top carriage with six bolts and washers and attach hand crankshaft housing to upper part of top carriage with two bolts and washers.

(3) Couple oil gear motor shaft with hydraulic drive shaft of elevating mechanism and replace coupling cover. Bolt oil gear motor unit to base.

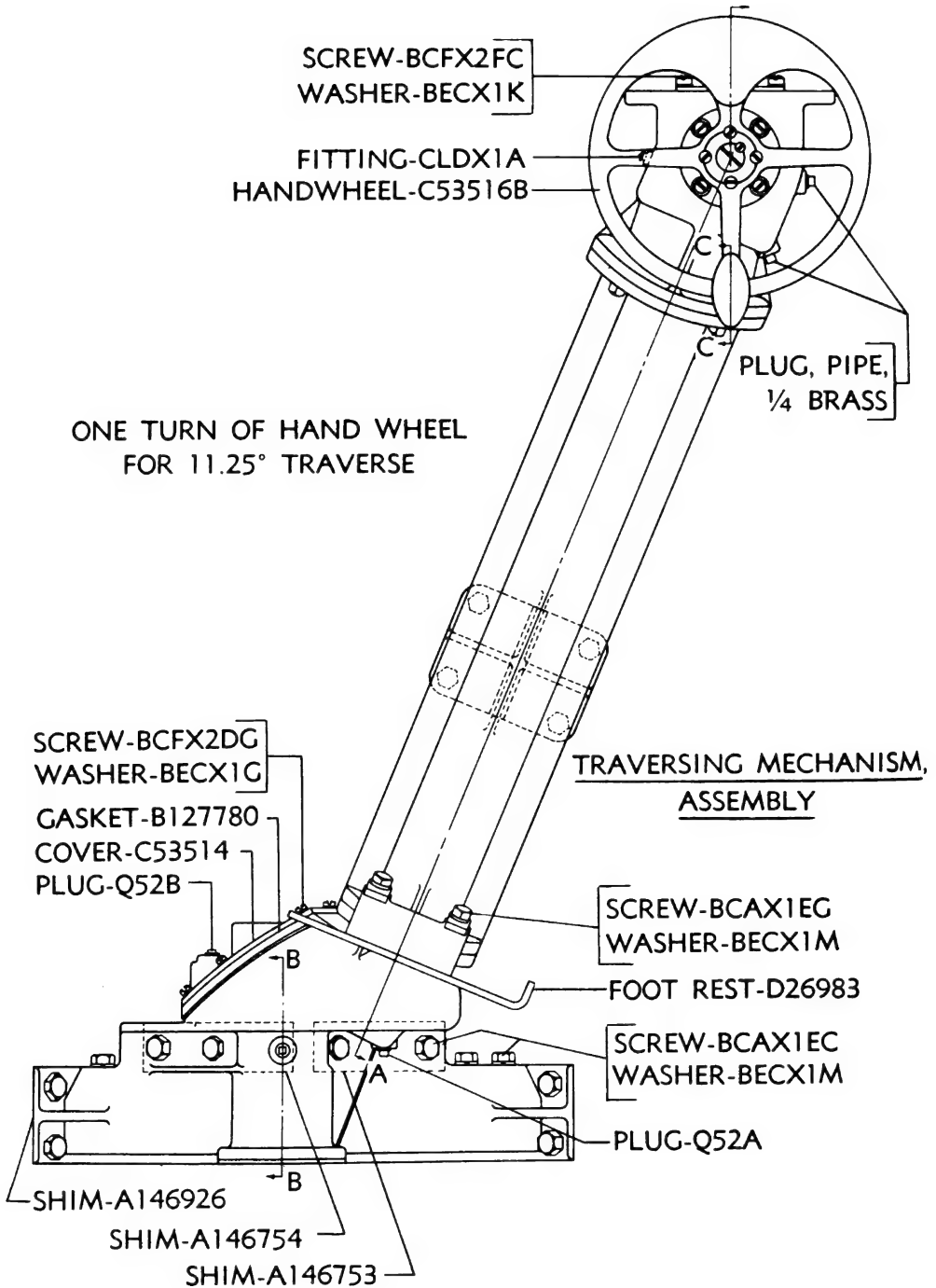
42. TRAVERSING MECHANISM, M3 AND M3E1 CARRIAGES.

a. Replacement of Parts. Backlash of over one-quarter turn of the handwheels, chattering gears, binding of the mechanism, or failure to traverse will indicate necessity for repair or replacement of parts.

b. Disassembly. Remove the Sighting System M2 from the carriage. Then disassemble the traversing mechanism in the following manner:

Part	Means of Support	Method of Removal
Case D26901 with gear shafts, handwheels, and other parts assembled.	Four screws BCAX1EF, nuts BBAX1E, and washer BECX1M.	Remove screws, nuts, and washers and lift assembled case from its seat on bracket D26900. Disassemble as described in the steps below.
Cover A147144.	Four screws BCFX2FG and washers BECX1K.	Remove screws and washers.
Case B160316 and inclosed gear B160314.	Four screws BCAX1CA and washers BEAX1L.	Remove screws and washers.
Gear B160314.	On shaft A147136.	Remove cotter pin BFAX1BE and drive out shaft in direction of headed end.
Bearings A147135.	Forced in gear B160314.	Force out, using equal pressure all around the bearing.
Handwheel C53515B.	Screws BCFX2BB and A147133.	Remove screws in order named.
Cover B160315.	Two screws BCKX2CF, four screws BCFX2DG and washers BECX1G.	Remove screws and washers.
Gear B160310.	Splined to shaft B160312.	Pull off the shaft.
Nut BBRX1AF and washer BEFX1AF.	Screwed to shaft B160308.	Unscrew.
Gear B160317.	Splined to shaft B160308.	Pull off the shaft.
Case C53684.	Three screws A147139 and washers BEAX1L.	Remove screws and washers.

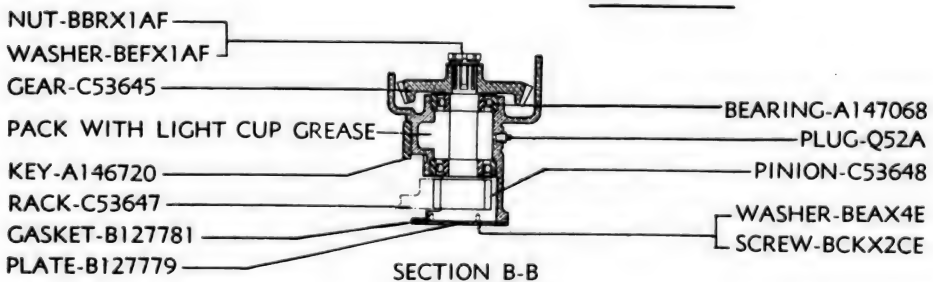
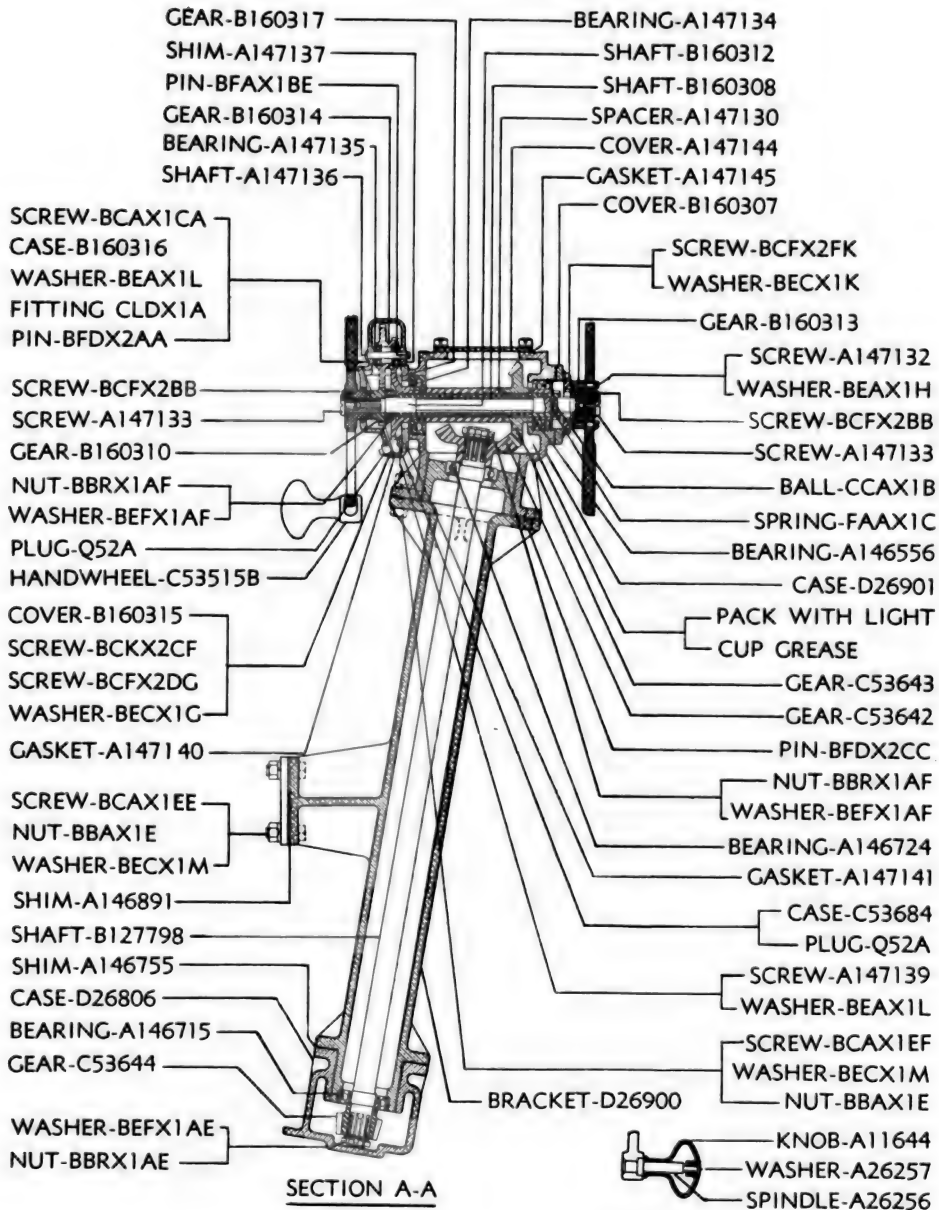
ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL



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Figure 85—Traversing Mechanism, M3 and M3E1 Carriages

MAINTENANCE AND REPAIR INSTRUCTIONS



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Figure 86—Traversing Mechanism Sections, M3 and M3E1 Carriages

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Part	Means of Support	Method of Removal
Handwheel C53516B, gear B160313, and shaft B160312.	Shaft B160312 fits in shaft B160308.	Drive out shaft B160312 toward the side of the handwheel by tapping opposite end. Be prepared to catch the spring and balls mounted in the shaft.
Handwheel C53516B.	On shaft B160312 by screws BCFX2BB and A147133.	Remove screws in order named.
Gear B160313.	On handwheel C53516B by four screws A147132 and washers BEAX1H.	Remove screws and washers.
Shaft B160308.	Secured in bearing A146556.	Drive out shaft. Use a wood block against the end of the shaft to protect it.
Cover B160307.	Four screws BCFX2FK and washers BECX1K.	Remove screws and washers.
Bearings A147134 and A146556.	Forced into case D26901.	Force out, using equal pressure all around the bearing.
Gear C53643 and spacer A147130.	Remove through bottom of case D26901.
Bracket D26900.	Four screws BCAX1EE, nuts BBAX1E, and washers BECX1M; four screws BCAX1EG and washers BECX1M.	Remove screws, nuts, and washers and lift the bracket out of its socket in the carriage. Shaft B127798, its gears, and nuts should lift out with the bracket.
Gear C53642.	Nut BBRX1AF and washer BEFX1AF.	Remove nut and washer.
Gear C53644.	Nut BBRX1AE and washer BEFX1AE.	Remove nut and washer.
Shaft B127798.	Secured by bearings A146715 and A146724.	Drive out through either end.
Bearings A146715 and A146724.	Forced into bracket D26900.	Force out, using equal pressure all around the bearings.
Case D26806 with pinion and gears assembled.	Eleven screws BCFX1EC, four nuts BBAX1E, and 11 washers BECX1M.	Remove screws, nuts, and washers and lift assembly from mount and disassemble as described in the following steps.
Cover C53514 and gasket B127780.	Seven screws BCFX2DG and washers BECX1G.	Remove screws and washers.
Plate B127779 and gasket B127781.	Five screws BCKX2CE and washers BEAX4E.	Remove screws and washers.

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Part	Means of Support	Method of Removal
Gear C53645, and pinion C53648.	Nut BBRX1AF. Gear is splined to pinion and pinion secured in bearing A147068.	Unscrew nut BBRX1AF. Drive pinion down and out of gear and remove gear through upper hole and pinion through the lower hole of gear case D26806.
Bearings A147068.	Forced in gear D26806.	Force out, using equal pressure all around the bearings.

c. Assembly.

(1) Assemble in the reverse order of disassembly. Bearings must be set in their sockets evenly and in line so that when a shaft is put through them, the bearings will not be displaced. An even amount of pressure should be applied all around the bearing when assembling to a shaft or casing.

(2) Lubricate as specified in paragraph 58.

43. TRAVERSING MECHANISM, M3A1 CARRIAGE.

a. Removal.

(1) Remove platform assembly as described in paragraph 36 a.

(2) Remove hand crank C87039 by pulling out plunger A143996 and lift crank from sleeve.

(3) Remove the small cover plate retained by six screws on rear side of azimuth indicator and disconnect the wires one at a time, taking care to mark each wire with tape on bands of wire so they may be replaced on proper posts at time of assembly.

(4) Remove azimuth indicator by taking out three screws that secure it to the upper traversing mechanism housing. Lift azimuth indicator straight up to avoid bending the vertical shafts in the traversing indicator mechanism. Leave the conduit attached to the upper carriage assembly when preparing to remove the traversing mechanism.

(5) Before removing the traversing mechanism, disconnect the wire conduit which is soldered to the upper flange of the traversing mechanism housing assembly. Heat may be applied to permit removal of conduit but extreme care should be used not to burn the insulation on wires within conduit.

(6) Disconnect hydraulic gear drive mechanism from the traversing mechanism by first removing four large screws and washers from its base; then remove cap screw, nut, and washer from top carriage brace B162258 but do not disturb the two cap screws which secure brace to trunnion frame.

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NOTE: Parts are labeled in breakdown illustrations on following pages.

Figure 87—Traversing Mechanism, M3A1 Carriage—Exploded View

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Figure 88—Removing Azimuth Indicator

(7) Remove coupling cover and disconnect coupling spring; then separate the shafts of the two units, moving the hydraulic drive gear mechanism away from the traversing mechanism.

(8) Break the traversing mechanism into two units by separating the



Figure 89—Disconnecting Top Carriage Brace

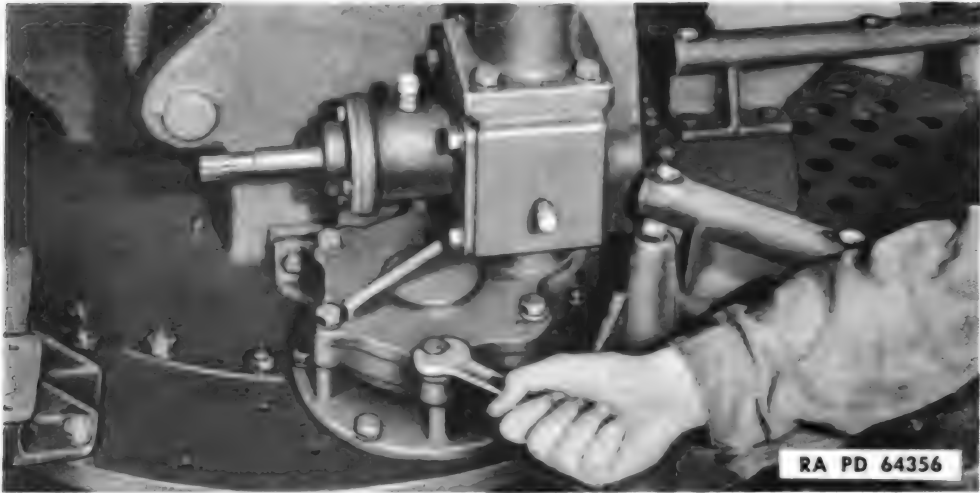


Figure 90—Separating Upper and Lower Traversing Mechanism Housings

upper housing D42229 from the traversing pinion housing D42230 by removing the four cap screws and washers where housings join.

(9) Remove upper traversing housing assembly by taking out two cap screws BCAX1EC which mount housing bracket to side of top carriage.

CAUTION: Shim for this connection should be attached to bracket or carriage so it will not be misplaced, and will be readily available when the mechanism is assembled. Be certain that all shims are either marked for proper position or attached to proper positions as this mechanism is disassembled.

(10) Remove eight screws BCAX1EC and washers which secure traversing mechanism lower housing to the top carriage (two of these screws are attached to the trunnion frame). Then remove housing.

b. Disassembly.

(1) Take screws BCGX1.1BC and A149006 in that order, and slide sleeve B162129 from gear, holding hand around inner end of sleeve in such a manner that balls CCAX1B and spring A149005 will be caught if wear has taken place to such an extent that balls may drop out of gear.

(2) Before removing gear B162130, balls CCAX1B and spring A149005 must be removed. The balls are retained in gear by slightly peening the edge of each hole after assembly; therefore, with a small drift pin, punch, or round file, enlarge the hole in one side of the gear and allow the ball to drop out. Then rotate the gear one-half turn, permitting the spring and other ball to drop out. Remove the gear.

(3) Remove screws and washers from cover B162143 of the assembly housing D42229 and take off cover. Make sure that gasket is removed and not misplaced.

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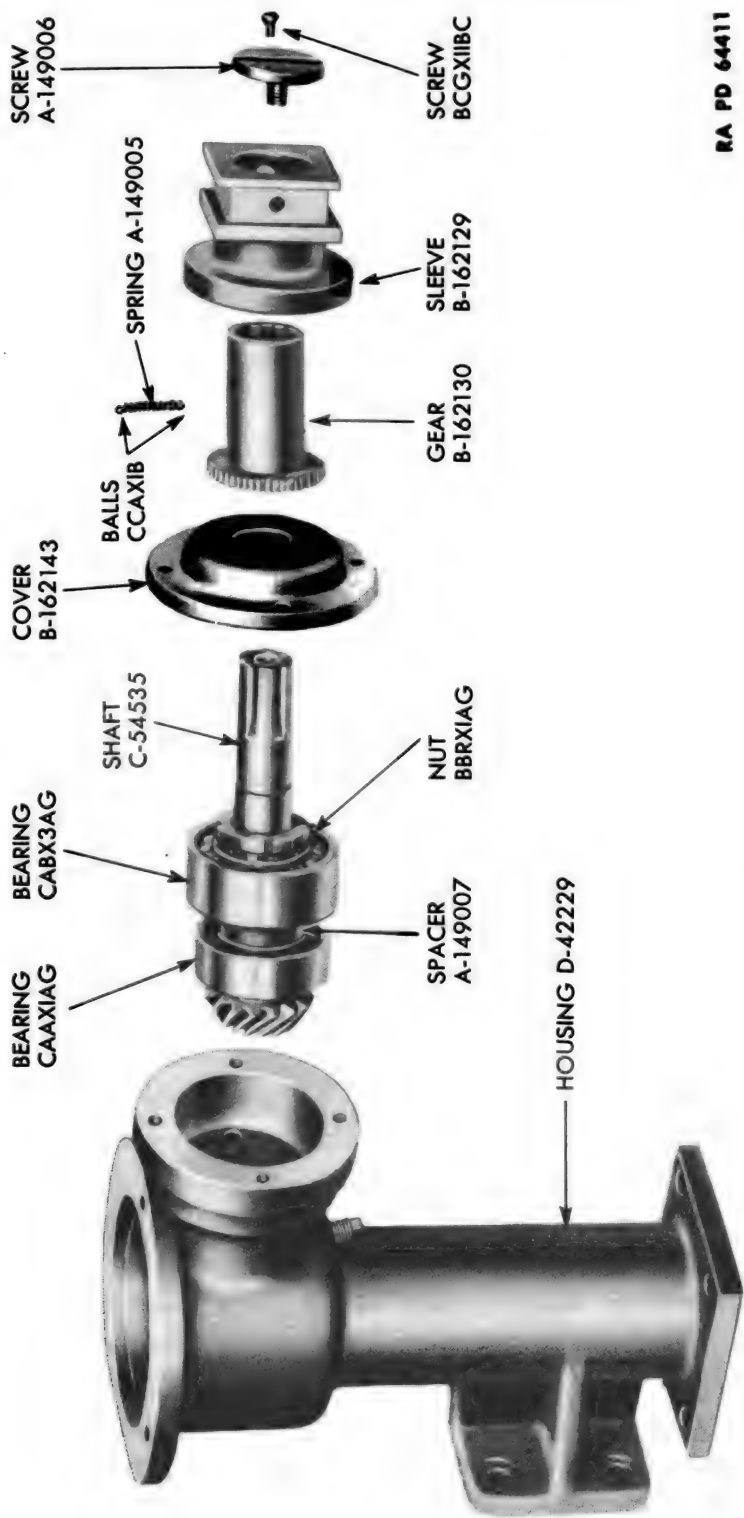


Figure 91—Traversing Mechanism Upper Housing Assembly—Exploded View

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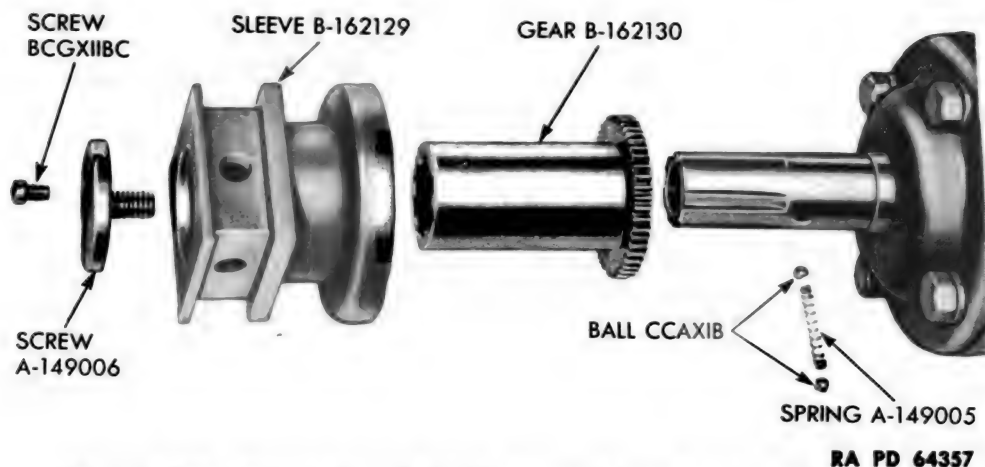
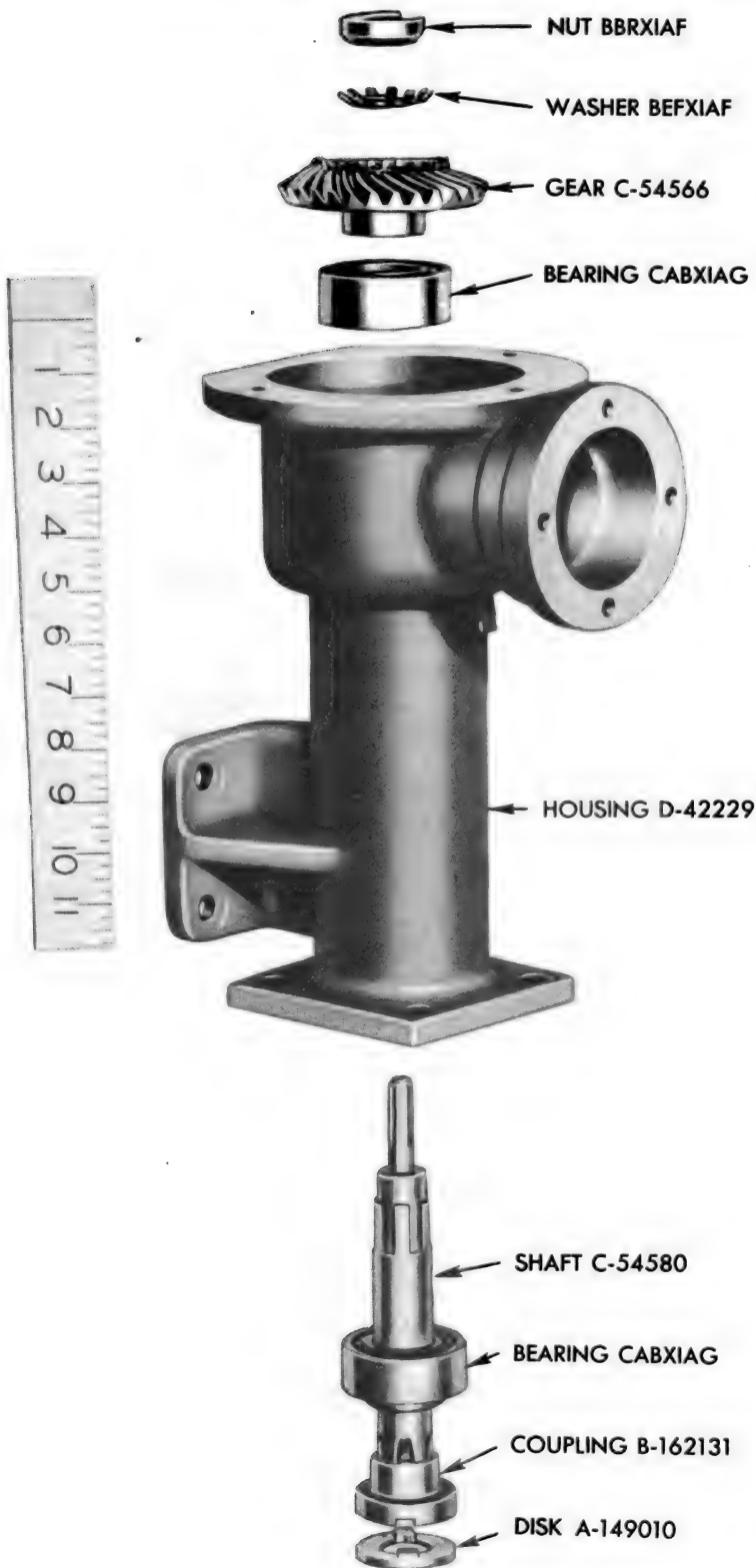


Figure 92—Hand Crankshaft Assembly—Exploded View

- (4) Pull pinion shaft C54535 from upper housing.
 - (5) Remove nut BBRX1AG and lock washer from outer end of shaft and press bearings from shaft. Spacer A149007 separates the two bearings.
 - (6) Remove nut and lock washer from upper end of the upper traversing gear shaft C54580.
 - (7) Press the shaft and lower bearing CABX1AG from housing D42229; remove through lower end of housing. Lift out gear C54566 and remove upper bearing CABX1AG through top of housing.
 - (8) Remove cotter pin which secures upper half of shaft coupling to lower end of shaft and remove coupling B162131 from shaft. Disk A149010 separates the upper and lower coupling.
 - (9) Remove four screws BCAX1EC and washers from traversing pinion housing C54541 and remove housing and traversing pinion assembly.
 - (10) Remove cover B162144 from housing and remove nut BBRX1AG and washer BEFX1AG from shaft. Press pinion and shaft from housing by pressing on splined end of shaft.
 - (11) Remove bearing CAAX1AM from inner end of housing and bearing CABX1AG from outer end of housing. The pinion sleeve A149130 which separates the two bearings should also be removed.
 - (12) Separate the traversing mechanism housing D42230 from lower housing D42215 by removing six cap screws and washers.
- NOTE: Two dowel pins BFDX2CE hold the two housings in alignment.
- (13) Remove lower half of coupling B162131 by taking out cotter pin and pressing coupling from lower traversing mechanism gear shaft.
 - (14) Remove nut BBRX1AF and lock washer BEFX1AF from lower end of shaft; then press small traversing gear B162147 from the shaft.

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Figure 93—Upper Traversing Mechanism Gear Shaft Assembly—Exploded View

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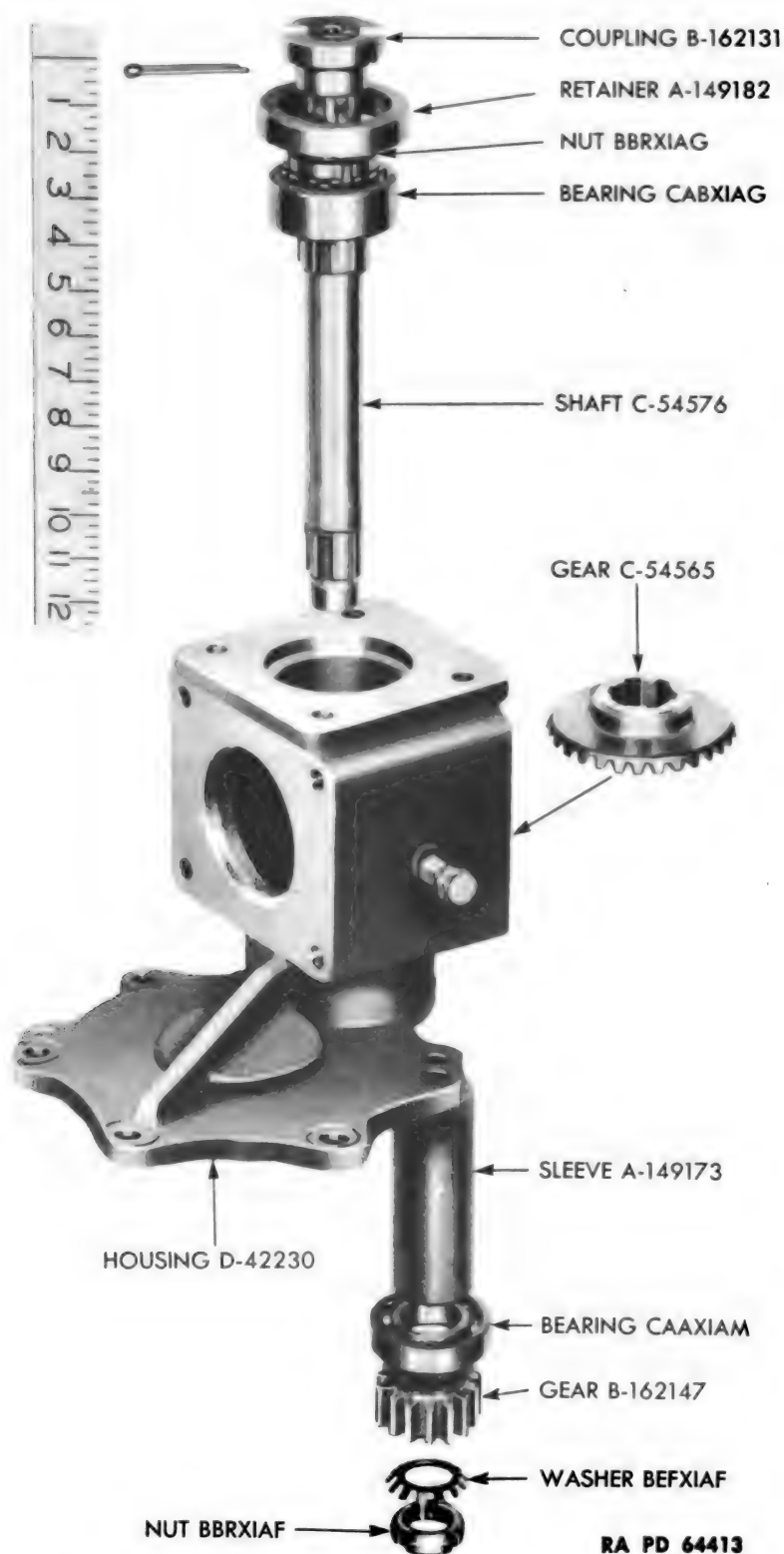
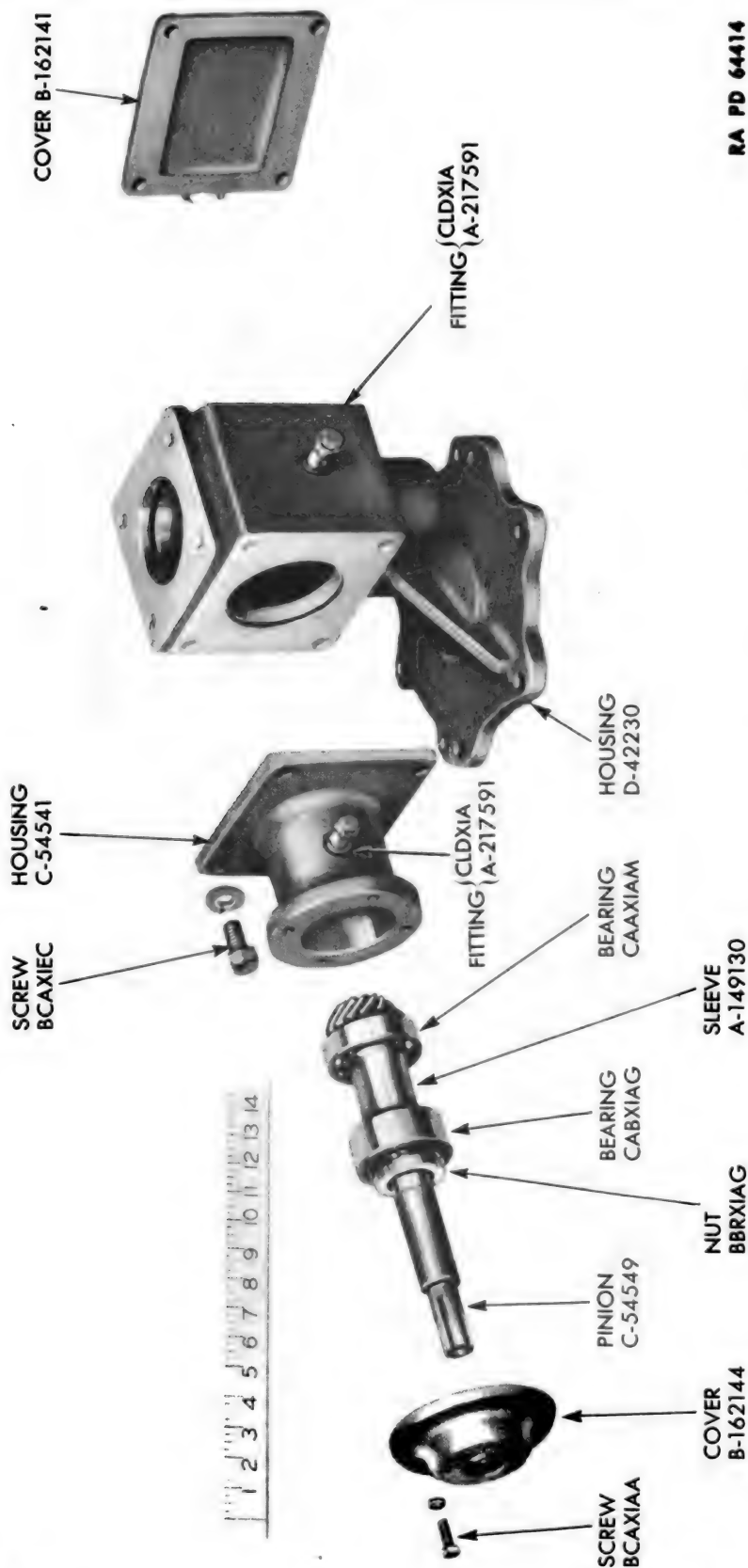


Figure 94—Lower Traversing Mechanism Gear Shaft Assembly—Exploded View

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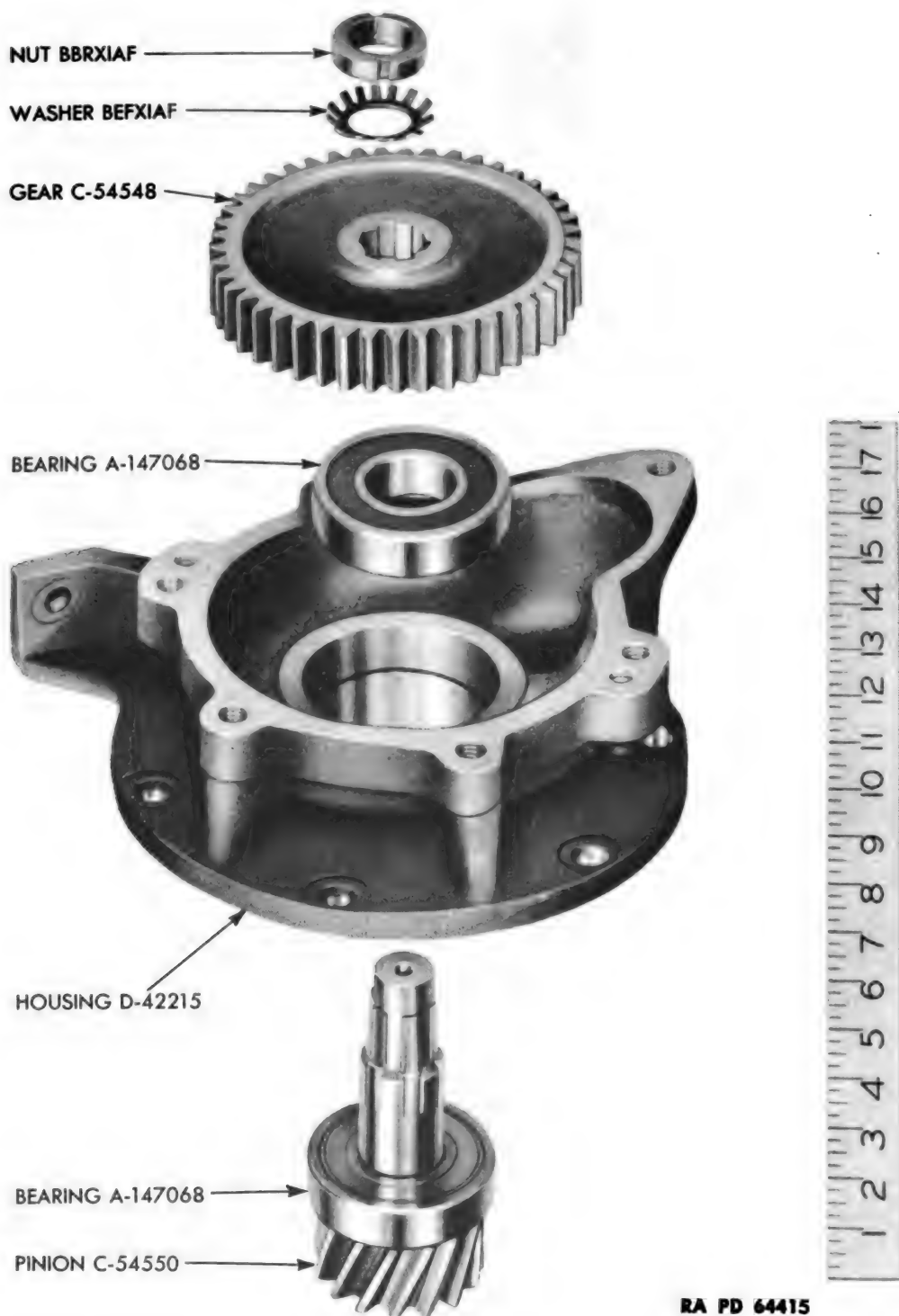


Figure 96—Traversing Mechanism Pinion Gear Assembly—Exploded View

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(15) Remove nut, lock washer, and bearing retainer A149182 from upper end of the shaft. Press shaft assembly downward and remove through bottom of housing.

(16) Remove traversing pinion from C54565 gear, and lower traversing shaft sleeve A149173 from housing. The sleeve separates gear C54565 and bearing CAAX1AM.

(17) Press bearings out of housing. Remove upper bearing through top of housing, lower one through bottom.

(18) Remove nut BBRX1AF and lock washer BEFX1AF from upper end of traversing pinion C54550 and press pinion down and out of gear C54548 and bearings A147068.

(19) Remove the large traversing gear and press bearing out of each end of housing.

c. Inspection.

(1) Clean all parts free of grease and dirt with SOLVENT, dry-cleaning. Oil before inspection. Ball bearings should be cleaned, oiled, inspected and wrapped in clean paper until installed. Any bearing which feels "rough" or "bumpy" when being rotated slowly under hand pressure should be replaced.

(2) All parts should be given a visual inspection for excessive wear, burs, and high spots denoting binding end play. Inspection for backlash between gears and between splined parts should be continued throughout assembly of mechanism, replacing parts as necessary to secure an assembled unit which can be operated without bind or backlash. Freedom of operation and absence of backlash are absolutely essential in this unit.

(3) Check hand crank C87039 for proper fit on hand crank sleeve, and remove with file any burs that roughen inside of crank connection. Inspect pressure of spring in hand crank plunger to make certain it gives proper security for holding crank in place. Check internal sleeve and gear B162130 for freedom of movement in and out of mesh, and remove any burs or obstruction which may interfere with easy operation.

(4) Inspect packing A149183 in cover. See that it makes a good seal on the hydraulic gear shaft. If new packing is used, make sure it is expanded into recess in the cover and does not bind shaft when cover is replaced.

(5) Shims have been provided at various points between housing to secure proper mesh of gear teeth without bind or backlash when gears are new. These shims should be replaced in original positions upon reassembly unless backlash in gears indicates that removal of shim will eliminate backlash and still give freedom of movement throughout entire gear range.

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d. **Assembly.** All gears are lapped in assembly, so gears having the same mating numbers and those having match marks should be assembled according to the markings. This will permit the fitting of the gears properly to obtain the best working point with the least backlash.

NOTE: Absolute cleanliness is essential when reassembling gears, bearings, and other parts of the traversing mechanism, to make sure that no foreign matter is allowed to remain in the unit and cause malfunctioning.

(1) Lubricate bearings A147068 and press them into lower traversing mechanism housing D42215 with shielded portions facing inward.

(2) Install pinion C54550 into housing D42215 and press gear C54548 on to pinion shaft, with deeper shoulder of gear hub down. Install washer and nut BBRX1AF and secure. Test for freeness of operation.

(3) Press small traversing gear B162147 onto gear shaft C54576 and enter shaft in lower opening of housing D42230. Slip bearing CAAX1AM and lower gear shaft sleeve A14973 on shaft from above, through top opening of housing. Withdraw the shaft a little from bottom and place gear C54565 in position in top opening of housing; then enter upper end of shaft in spline of gear and press gear into position. Install retainer A149182, bearing CABX1AG, lock washer, and nut BBRX1AG, and tighten nut firmly. Install lower half of coupling B162131. Check for freeness of operation; there should be no binding or end play in this assembly.

(4) Couple housing D42230 to housing D42215 and secure with six bolts BCAX1ED and washers. Make sure punch marks on gears of these two assemblies align so mesh will be correct. After the two housings are secured in place, there should be no backlash and operation should be free.

(5) Install bearing CAAX1AM and sleeve A149130 onto pinion C54549 and press this assembly into housing C54541 from inner end of housing. Install bearing CABX1AG, washer, and nut BBRX1AG on pinion from outer end of assembly housing. Tighten nut until end play has been removed; then check for freeness of operation.

(6) Install gasket and cover B162144; secure with four screws and washers.

NOTE: Be sure packing A149183 in cover is in good position and forms a seal around shaft.

(7) Bolt housing C54541 to housing D42230.

(8) Press coupling onto upper traversing gear shaft C54580 and lock with cotter pin. Install bearing CABX1AG from top end of shaft, and press into position against shoulder of shaft.

(9) Press assembled shaft and coupling into housing from bottom. Install upper ball bearing CABX1AG over shaft and into housing.

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(10) Press upper traversing spiral gear C54566 onto shaft and lock with washer and nut.

(11) Install traversing mechanism coupling and lower coupling disk A149010 between upper and lower couplings B162131 and bolt upper housing D42229 to housing D42230, making sure gasket is in proper place.

(12) Press bearings CABX3AG and CABX1AG into traversing pinion shaft C54535 and lock with washer and nut BBRX1AG.

(13) Press shaft assembly into housing D42229.

(14) Replace cover B162143 and secure with four cap screws and washers.

(15) Install hand crank gear B162130 on shaft, alining hole in gear with the hole in shaft. One hole in the bronze gear should be closed just enough to hold the ball. With this hole on the bottom, drop ball CCAX1B and spring A149005 in place and insert the other ball. Use a drift pin slightly larger than the drilled hole to peen the edge of the hole. Close the hole just enough to keep the ball from coming out.

(16) Slide sleeve B16129 over the gear. Then replace screw A149006 and lock screw BCGX.1BC.

(17) Replace crank C87039 and secure by releasing plunger into crank sleeve slot.

e. Installation.

NOTE: It is recommended that the traversing mechanism be installed in two sections.

(1) Install assembled lower traversing housing and secure with eight cap screws and washers.

(2) Connect upper housing with lower housing, drawing down all bolts evenly in order to prevent distortion.

(3) Bolt upper bracket of mechanism to carriage with two bolts, making certain that shim provides proper alinement.

(4) Place azimuth indicator onto traversing mechanism and secure with three cap screws and washers.

(5) Connect wires to azimuth indicator terminal block, making sure that wires are properly connected; replace gasket and cover of terminal block.

(6) Connect hydraulic gear drive with traversing mechanism by coupling the shafts and bolting oil gear mechanism in place. Attach top carriage brace B162288.

(7) Replace hydraulic drive coupling cover.

(8) Install platform assembly as described in paragraph 36 d.

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL**44. TOP CARRIAGE.****a. General.**

(1) The top carriage assembly may be removed when it is assembled with the platform, oil gears, motors, etc., or it may be removed after removing all the assemblies mounted on it.

(2) It will be practical, when servicing the traversing thrust bearing, traversing rack or leveling mechanism, to remove the assembled top carriage.

(3) When the top carriage is to be disassembled, allow the top carriage assembly to remain on lower carriage until the oil gears, motors, platform, etc., have been removed.

b. Removal of Assembled Top Carriage.

(1) Remove cartridge case deflector from contact ring cap C78147 by removing four screws, two from the case of the deflector, and two from the clamp holding rear portion of deflector to trunnion upright.

NOTE: To remove cartridge case deflector D42387 from M3 Carriage, remove the lower screw from guard B127868 of elevating mechanism, the lower screw from inner trunnion bearing housing of equilibrator, and the screw with nut from top carriage. To remove cartridge case deflector D42390 from M3E1 Carriage, remove the lower screw from guard B127868 of elevating mechanism and the lower screw from inner trunnion bearing housing of equilibrator.

(2) Remove contact ring cap by removing six screws and washers. This separates contact ring and housing from top carriage.

CAUTION: Before cap is removed, mark cap and housing so cap can be properly replaced, as the holes in housing are irregularly spaced.

(3) Remove 10 screws from top cover of gun junction box, and remove cover.

(4) Disconnect 15 wires from terminal posts inside of gun junction box, marking the wires so that they can be properly replaced; then remove three screws from terminal post housing, and remove the housing from junction box.

(5) Remove contact ring cable from gun junction box by unscrewing the retaining nut on cable, and pulling cable from junction box.

(6) Remove the circular steel plate from under side of chassis, directly beneath the leveling mechanism, by removing eight cross recess head screws, and remove cable from the plate.

(7) Unscrew retaining nut on cable from leveling socket clamp, and remove the conduit from contact ring cable.

(8) Tape exposed wires together at end of contact ring cable, in order

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Figure 97—Separation of Contact Ring Assembly and Housing from Top Carriage

that cable may pass through opening in leveling socket when top carriage is lifted.

(9) Remove direct fire sights.

(10) Remove platform assembly as described in paragraph 36 a.

(11) Remove foot firing mechanism housing from top carriage, removing four cap screws.

(12) Remove 22 flat-head screws, nuts, and lock washers from base of top carriage, using a $\frac{9}{16}$ -inch wrench on the nut, and a heavy-duty screwdriver.

CAUTION: Eighteen of the screws are of the same length, and four are shorter. Keep screws separated so that they can be replaced correctly.

(13) Level top carriage, using leveling jacks, and check the leveling vials so that the bubble is exactly centered on both vials.

(14) Ring top carriage, and using chain hoist, or other suitable means, lift top carriage slowly from lower carriage.

NOTE: Three men are needed in the above operation: one to handle the chain hoist or rigging; one to keep top carriage balanced, by using hand support as top carriage is being lifted; and one to ease the traversing pinion off the traversing rack, while rotating the traversing hand crank slightly, to prevent binding of the pinion and rack. At the same time, check the separation of the pinion from the rack and leveling

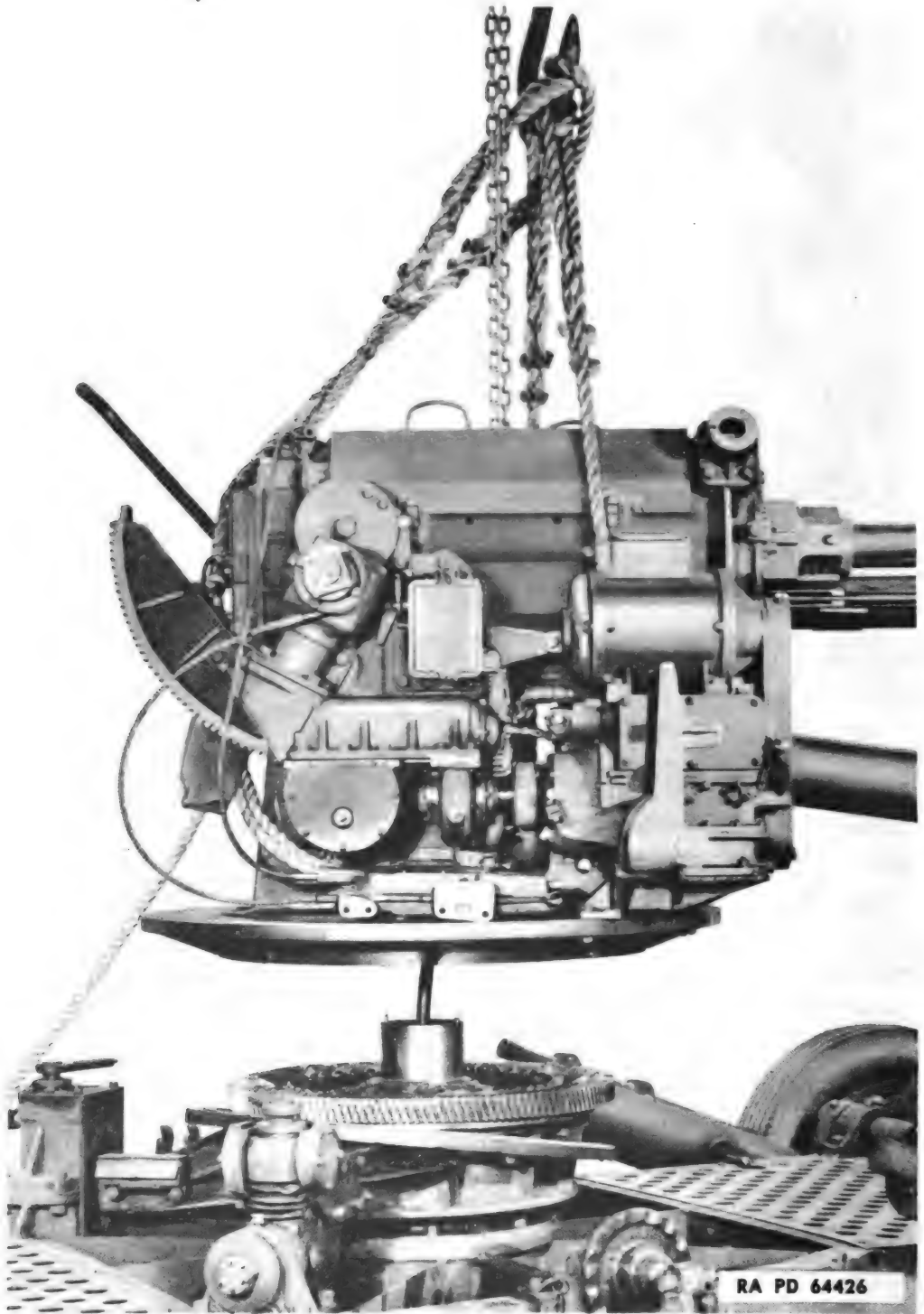


Figure 98—Lifting Assembled Top Carriage

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socket collar by looking beneath top carriage as it is being raised. As top carriage is raised, the contact ring cable should be pulled through opening in leveling socket collar, and away from the lower carriage.

CAUTION: Be sure no shims stick to bottom of top carriage as it is lifted from lower carriage. Wire all shims in proper position on the top carriage clip.

c. Installation of Assembled Top Carriage.

(1) Rig top carriage, and lower to a point about one foot above leveling socket, and line up collar on leveling socket with opening in bottom of top carriage.

NOTE: Top carriage must be rigged so as to hang exactly level above lower carriage, and as carriage is lowered, there must be a man checking the positioning of the leveling socket collar with relation to the opening in the top carriage base.

(2) Thrust contact ring cable through opening in leveling socket, and draw down through leveling socket.

(3) Lower top carriage slowly, fitting leveling socket collar into opening provided on base of top carriage, and securing proper mesh of the traversing pinion and traversing rack.

NOTE: Three men are necessary in the above operation: one to handle chain hoist or rigging in lowering the top carriage; one to balance top carriage using hand support, as leveling socket collar enters the opening in base of top carriage; and one to check the positioning of collar and the mesh of traversing pinion and rack while rotating the traversing hand crank to obtain proper mesh.

CAUTION: See that top carriage clip is free from base of top carriage, as it may become wedged between the top and lower carriage as top carriage is being seated. After top carriage is seated securely, traverse top carriage using hand crank, to see that proper seating and mesh has been obtained.

(4) Install the 22 screws, lock washers, and nuts securing top carriage to top carriage clip and lower carriage, making certain that wires have been removed from shims on clip, and that shims are properly positioned.

(5) Install foot firing mechanism housing on top carriage as described in paragraph 38 e.

(6) Install platform assembly as described in paragraph 36 d.

(7) Install direct fire sights.

(8) Install contact ring cap C78147 by installing six washers and screws.

CAUTION: Adjust base of contact ring housing until the two slots engage the two studs on leveling socket collar.

(9) Install cartridge case reflector, installing four screws, two through

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base of deflector and two through the clips holding deflector to the bar between trunnion uprights.

(10) Replace conduit on contact ring cable and screw nut firmly against leveling socket clamp.

(11) Replace circular steel plate on under side of chassis by passing contact ring cable through hole in the plate; then secure plate to chassis with eight cross recess head screws.

(12) Place contact ring cable in gun junction box opening, and screw retaining nut against junction box. Replace gun junction box terminal post housing, and install contact ring cable in gun junction box by thrusting cable through opening in box, removing tape from end of cable, and attaching each of the 15 wires to its proper terminal post. Replace gun junction box cover, installing the 10 screws.

d. Disassembly of Top Carriage.

(1) Remove gun from cradle.

(2) Remove equilibrator as described in paragraphs 32 b and 34 a.

(3) Remove cradle as described in paragraph 35 b.

(4) Remove platform assembly as described in paragraph 36 a.

(5) Remove foot firing mechanism as described in paragraph 38 a.

(6) Remove taper pin from foot firing rest pedal assembly, using small hammer and drift.

(7) Unscrew foot firing rest pedal assembly, and remove from top carriage.

(8) Remove foot firing cable pedal assembly from top carriage, using same procedure as on the rest pedal assembly.

(9) With a small screwdriver, remove rubber seal from oil gear coupling, elevation, and azimuth, pushing seal off coupling away from oil gear.

(10) Remove coupling retainer spring from each oil gear, using small screwdriver to start the spring off; then insert larger screwdriver and rotate coupling until the spring is free.

(11) Remove top cover from each oil gear motor terminal block, removing six nuts with a $\frac{7}{16}$ -inch wrench.

(12) Disconnect three wires from terminal block of each oil gear, marking the wires so they may be replaced accordingly.

(13) Remove conduit from terminal block of each oil gear, removing four screws and washers with a small screwdriver.

(14) Remove side plate cover from each oil gear, removing six nuts with a $\frac{7}{16}$ -inch wrench.

(15) Disconnect five wires from the terminal posts of each oil gear, marking them so they may be replaced accordingly. Do not disconnect

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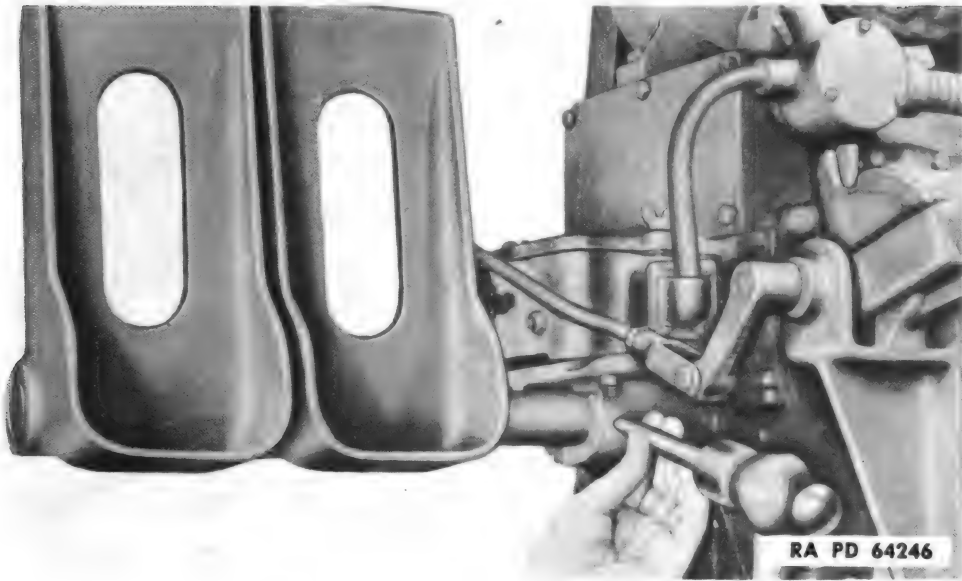


Figure 99—Removing Taper Pin from Foot Firing Rest Pedal Assembly



Figure 100—Removing Foot Firing Rest Pedal Assembly

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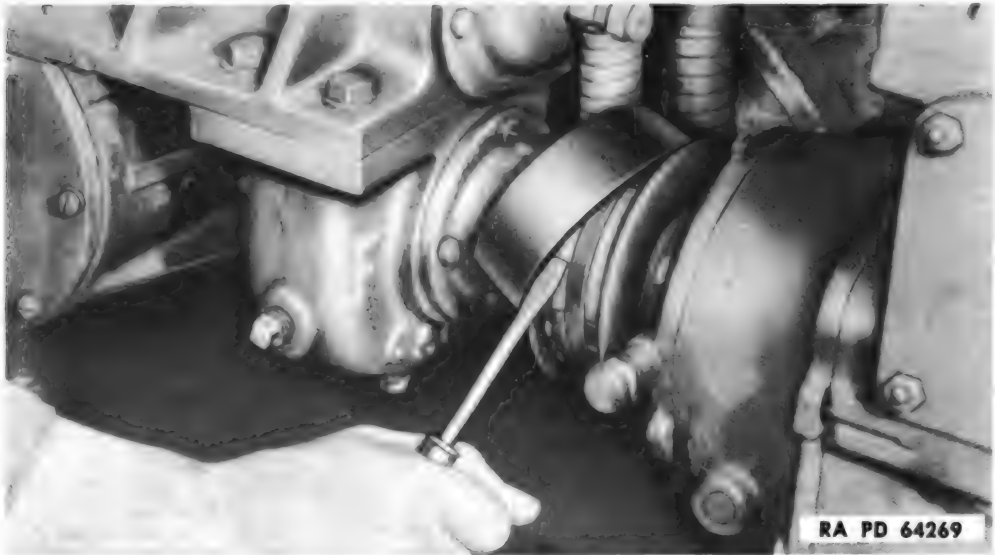


Figure 101—Removing Rubber Seal from Oil Gear Coupling

the wires which connect the two "synchro" units to each other, for these do not interfere with removal of oil gear units.

(16) Remove three screws from conduit junction box cover of each oil gear unit, using small offset screwdriver. Remove the covers.

(17) Remove four bolts, nuts, and washers securing elevation oil gear to bracket. Remove nut, screw, and washer from top carriage brace on

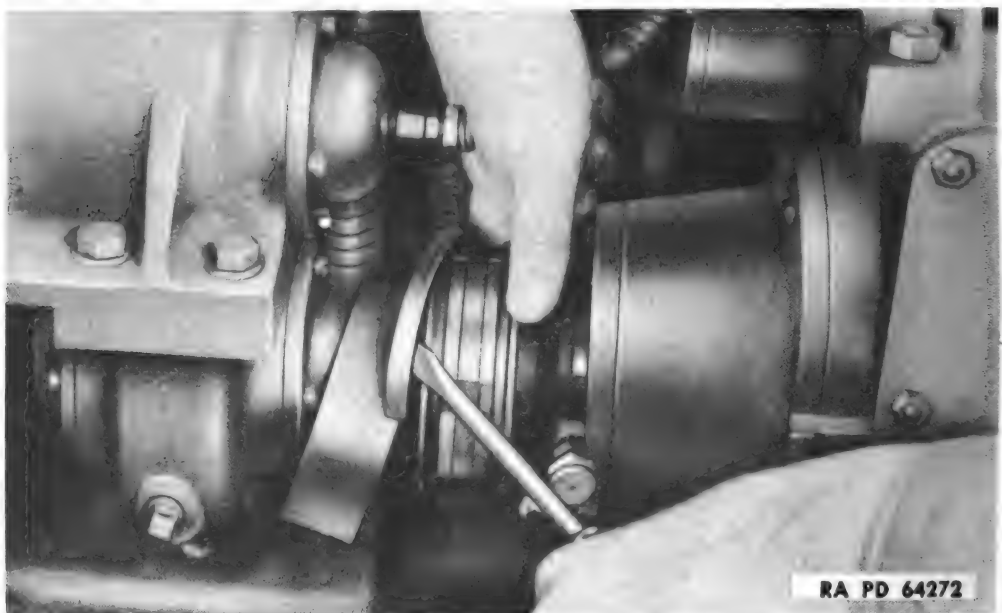


Figure 102—Removing Coupling Retainer Spring

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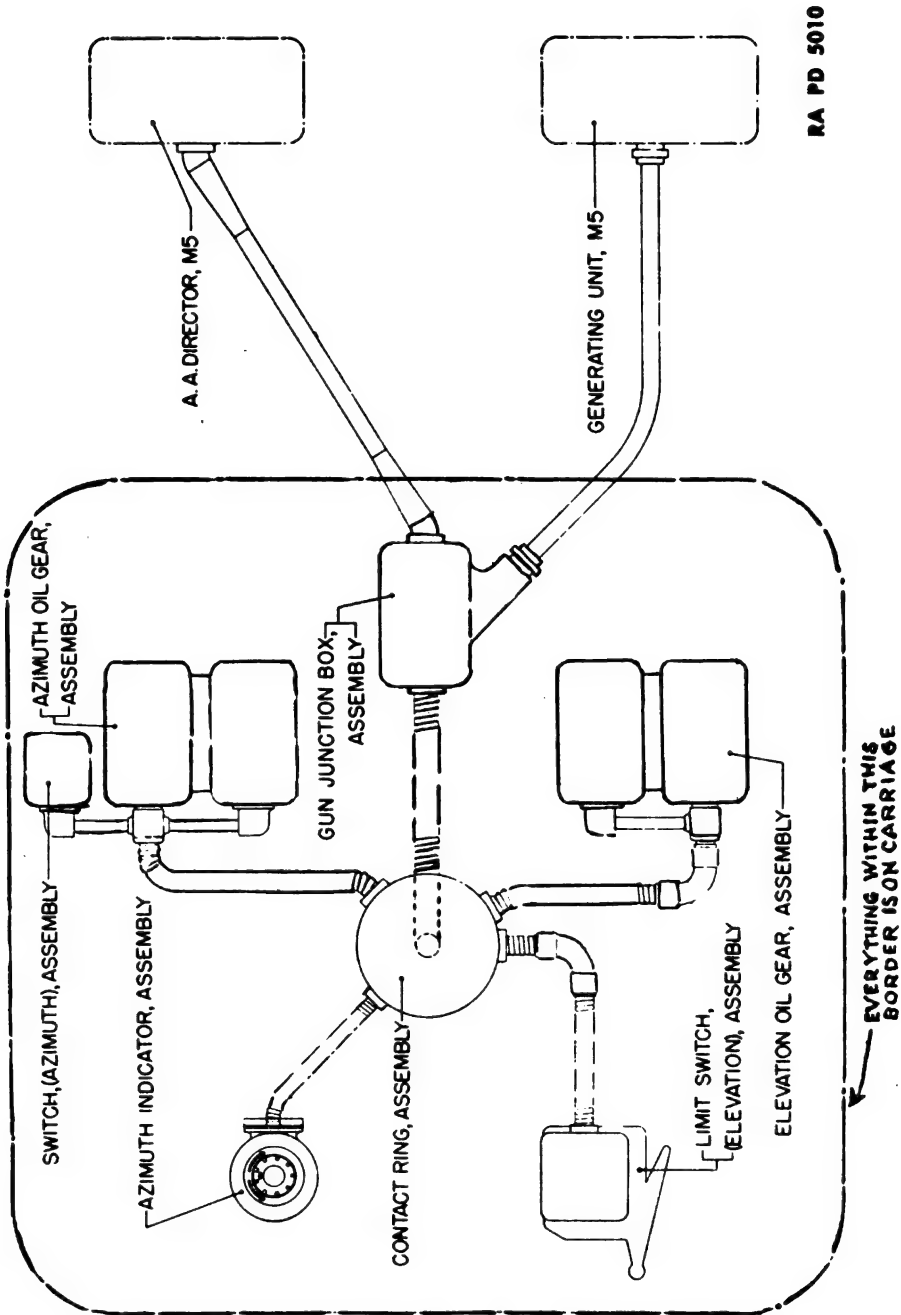


Figure 103—Remote Control System M1—Arrangement of Components

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Figure 104—Removing Top Cover from Oil Gear Motor Terminal Block

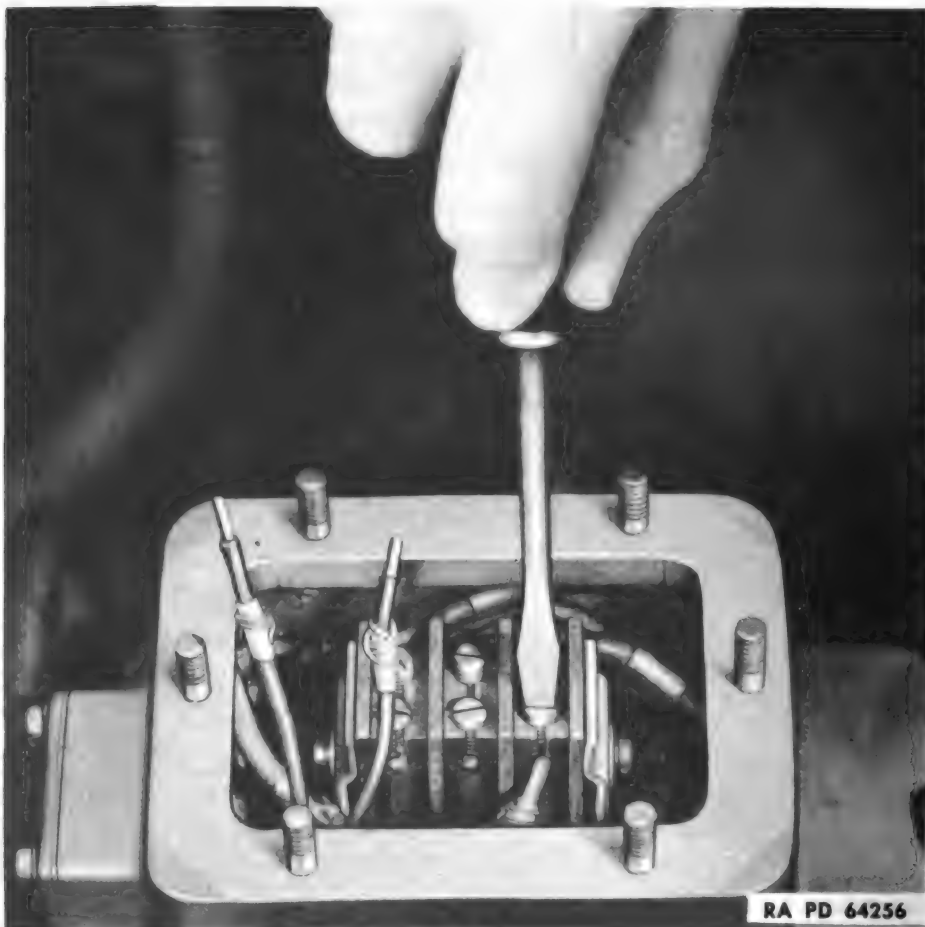


Figure 105—Disconnecting Wires from Terminal Block

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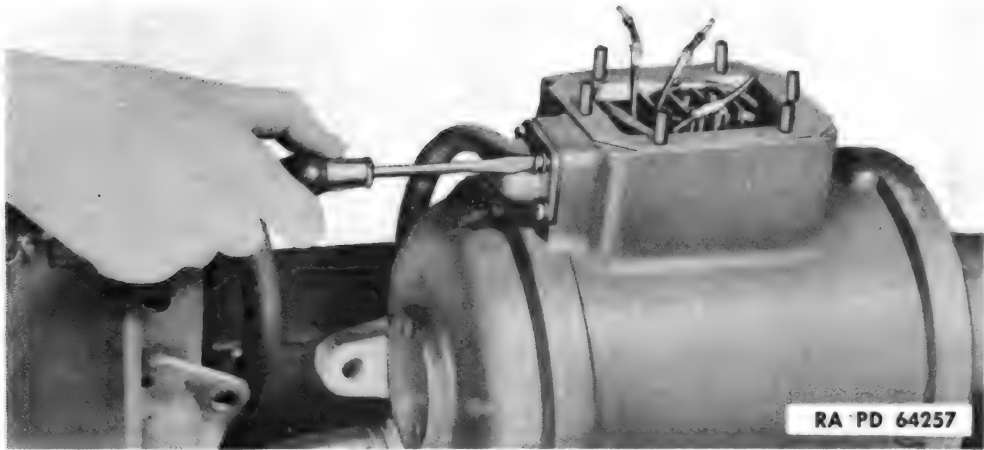


Figure 106—Removing Conduit from Terminal Block

oil gear, and slide oil gear away from elevating mechanism to a point where a small screwdriver can be inserted to remove three screws from the inside of the conduit junction box.

(18) Remove hydraulic gear switch assembly as described in paragraph 39.

(19) Remove the three screws from conduit junction box of azimuth oil gear, using small screwdriver; then remove the four bolts, nuts, and washers from base of oil gear. Remove nut, screw, and washer from top carriage brace on oil gear, and remove both oil gear units from carriage,

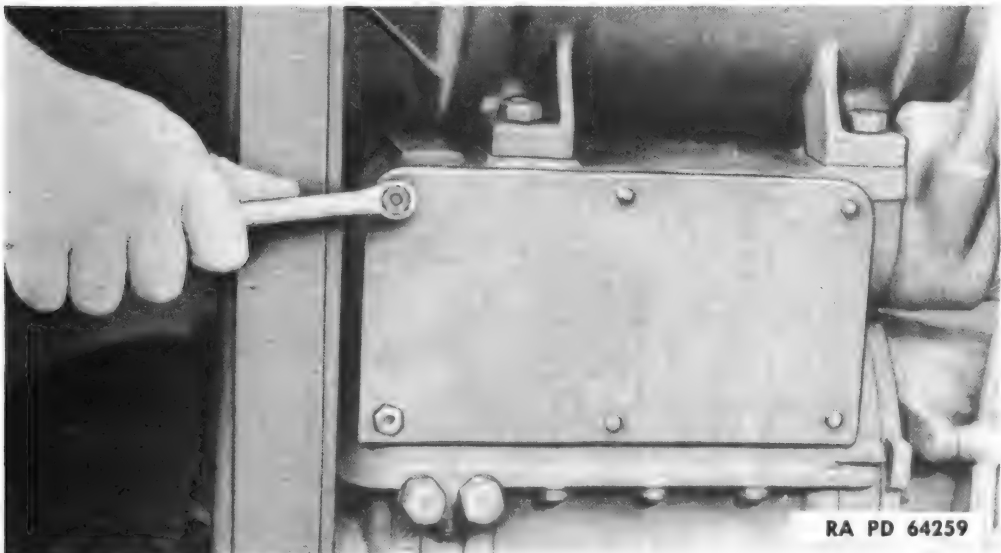


Figure 107—Removing Oil Gear Side Plate Cover

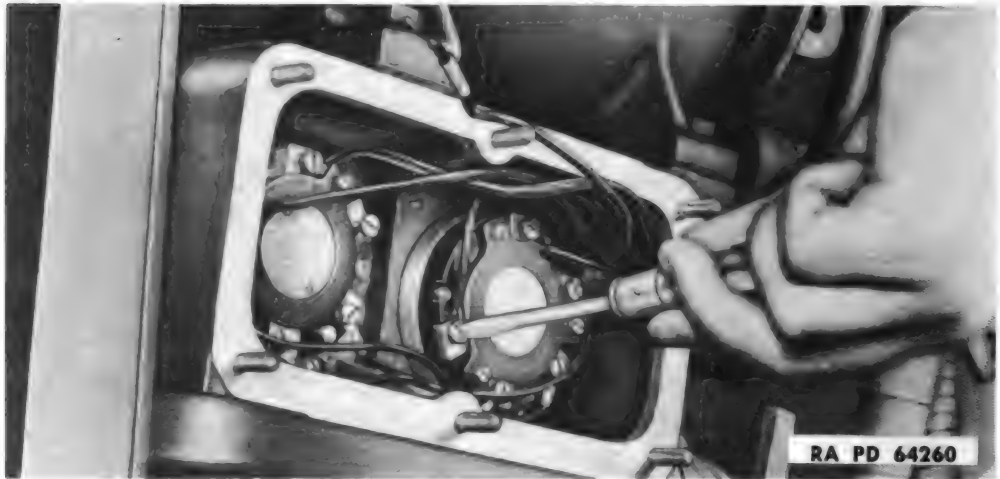


Figure 108—Disconnecting Wires from Oil Gear Synchro-transmitter

drawing wiring connections through and away from the oil gear carefully so as not to disturb the markings on the wires.

CAUTION: Oil gears must be kept level at all times in order to prevent oil from entering the electrical units above the oil gear motors.

NOTE: Both oil gears are shimmed at the bases, and these shims should be wired to the oil gear brackets when oil gears are removed. The oil gear side plate covers and terminal block top covers should be replaced to prevent dirt from entering the oil gear assembly.

(20) Disconnect six wires from the terminal posts in azimuth switch, and mark them so they may be replaced on their proper terminal posts.

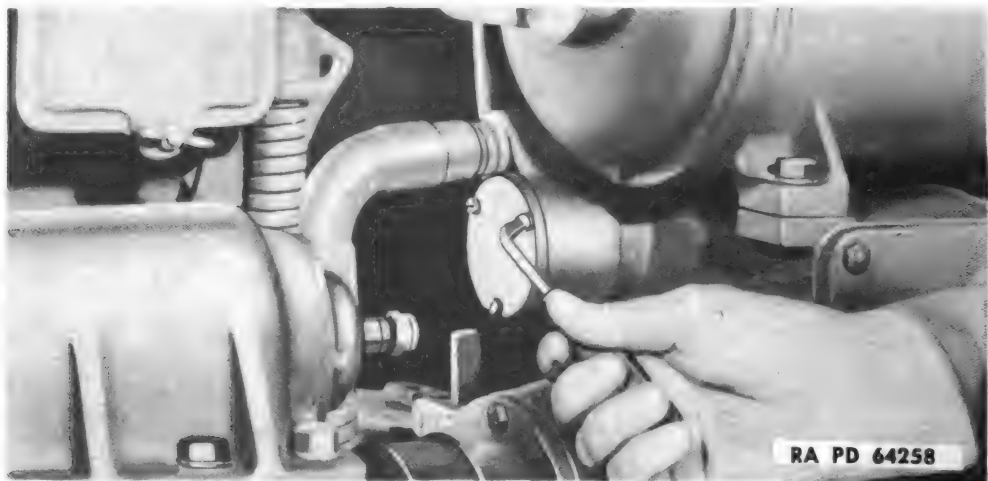


Figure 109—Removing Cover from Conduit Junction Box

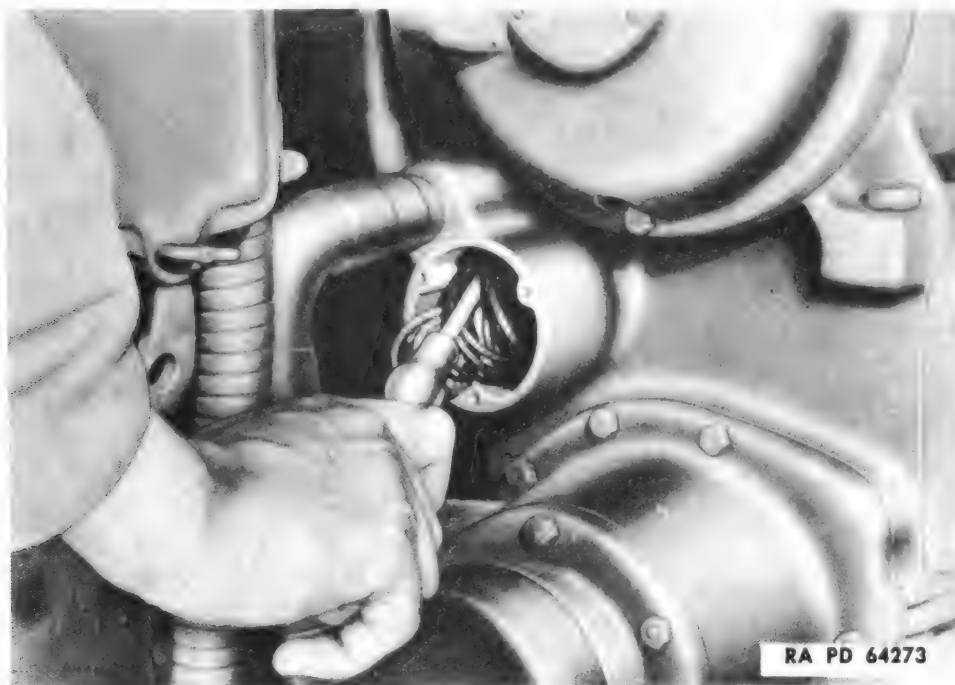
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Figure 110—Removing Conduit Junction Box

(21) Remove four screws from conduit at azimuth switch, using small screwdriver.

(22) Remove azimuth switch by removing four bolts, nuts, and washers; use a $\frac{1}{2}$ -inch wrench on the bolt, and a $\frac{9}{16}$ -inch wrench on the nut.

(23) Disconnect six wires from elevation limit switch terminal posts, marking the wires so they can be replaced accordingly.

(24) Remove four screws from conduit on elevation limit switch, using small screwdriver, and pull wires through and away from elevation limit switch.

(25) Remove two screws holding elevation limit switch to top carriage, and remove the switch.

(26) Remove azimuth indicator and traversing mechanism as described in paragraph 43 a.

(27) Remove elevating mechanism as described in paragraph 41 a.

(28) Remove cartridge case deflector by removing the two cap screws securing deflector to contact ring housing, and the two cap screws securing deflector to the bar between trunnion uprights.

(29) Remove contact ring cap, remove contact ring cable from gun junction box, remove cover from underneath chassis, and remove conduit from contact ring cable as described in paragraph 44 b.

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Figure 111—Removing Oil Gear Assembly

(30) Level top carriage.

(31) Remove the 22 screws, nuts, and lock washers from base of top carriage as described in paragraph 44 b.

(32) Rig top carriage and lift slowly from lower carriage, using chain hoist or other suitable means, taking care to withdraw contact ring from opening in leveling socket as carriage is lifted.

NOTE: Wire shims to top carriage clip, and check to see that no shims stick to bottom of top carriage base.

(33) Remove traversing thrust bearing from recess in leveling socket.

NOTE: Before removing traversing rack, mark rack and adjacent flange of leveling socket, so the rack can be replaced in its original position.

(34) Remove 12 bolts and nuts from the traversing rack, and remove rack from leveling socket.

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Figure 112—Disconnecting Wires from Azimuth Switch

e. Inspection.

(1) Clean and inspect traversing bearing, examining each ball for chips, roughness, and discoloration. Check bearing surfaces of upper and lower race. A complete new bearing should be installed, should parts show excessive wear or usage.

(2) Inspect teeth of traversing rack for signs of improper mesh of the traversing pinion, and check for burs. Replace rack if worn or damaged.

NOTE: If bearing has been cleaned with solvent, dry it thoroughly before applying lubricant.

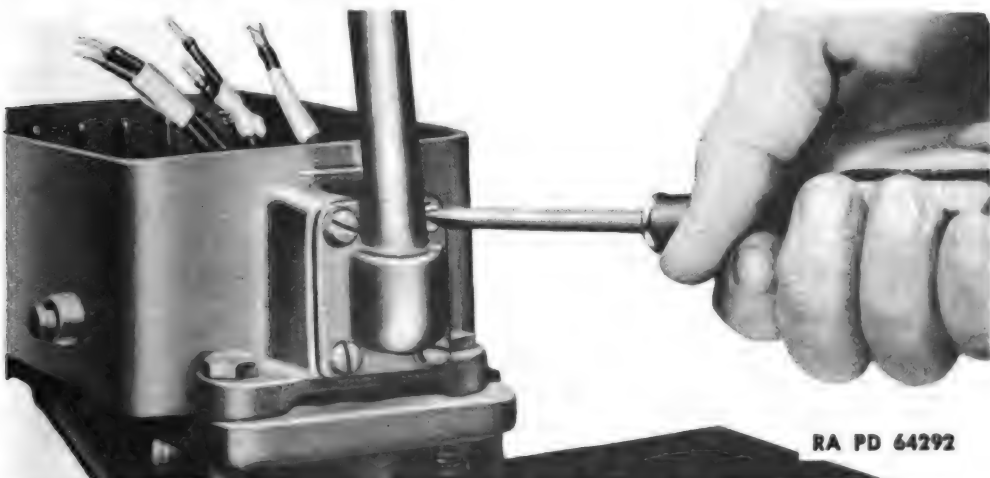


Figure 113—Removing Conduit from Azimuth Switch

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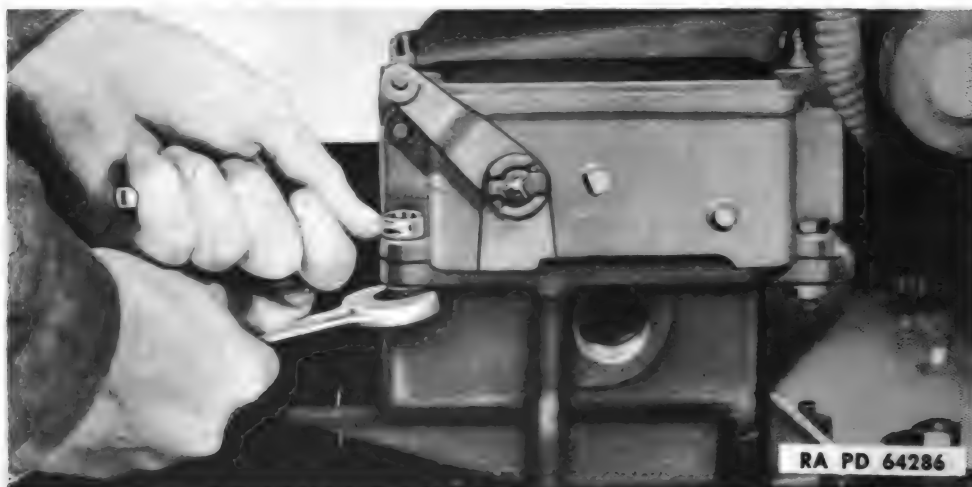


Figure 114—Dismounting Azimuth Switch

(3) Coat ball retainer and both races with GREASE, O.D. (seasonal grade), working lubricant into spaces between ball bearings. Assemble bearing and keep covered until installed.

f. Assembly of Top Carriage.

(1) Place traversing thrust bearing in recess of leveling socket.

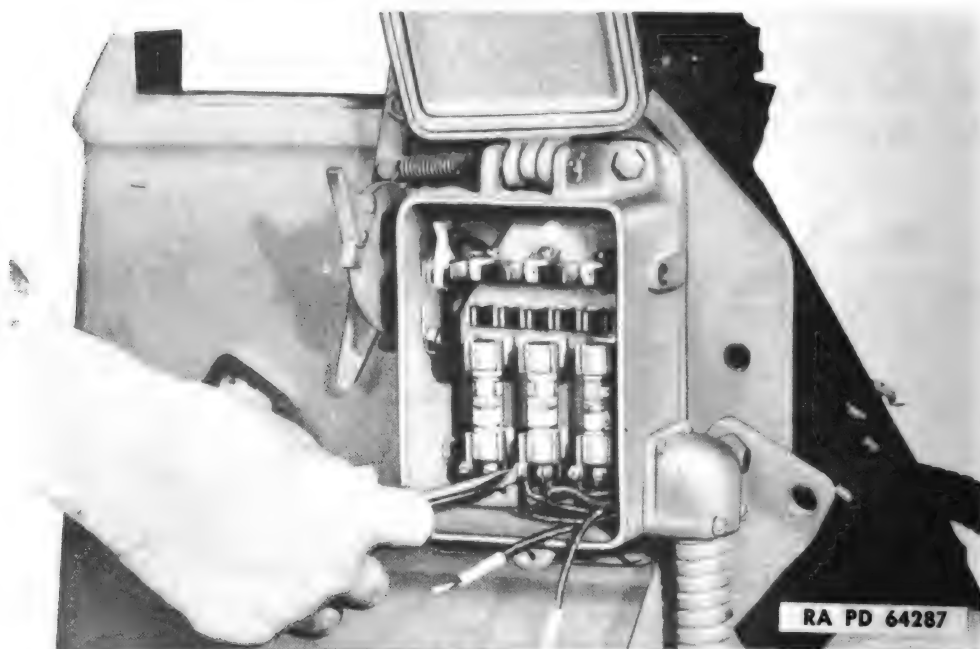


Figure 115—Disconnecting Wires from Elevation Limit Switch

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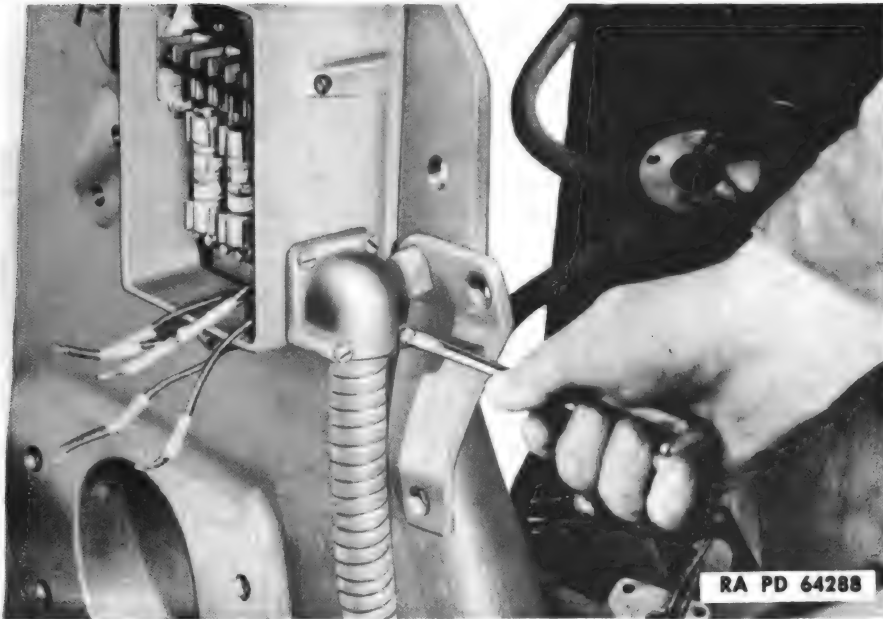


Figure 116—Removing Conduit from Elevation Limit Switch

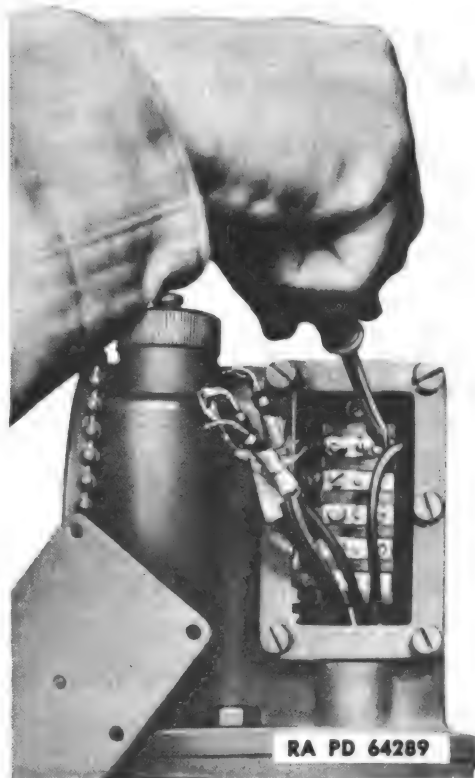
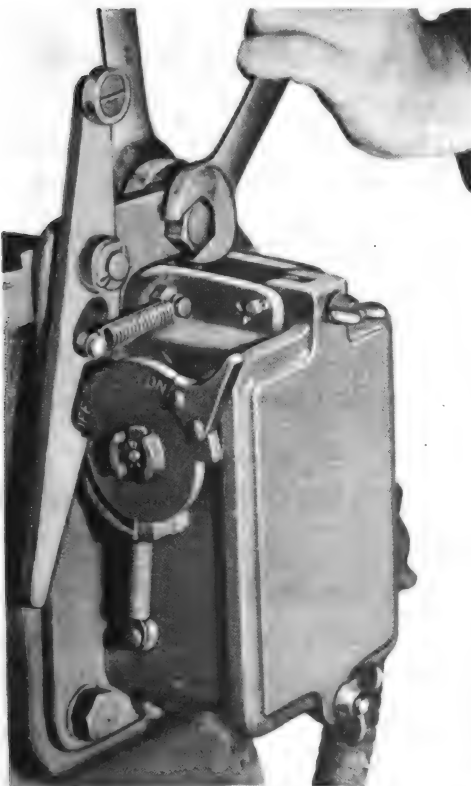


Figure 117—Dismounting Elevation Limit Switch; Disconnecting Wires from Azimuth Indicator

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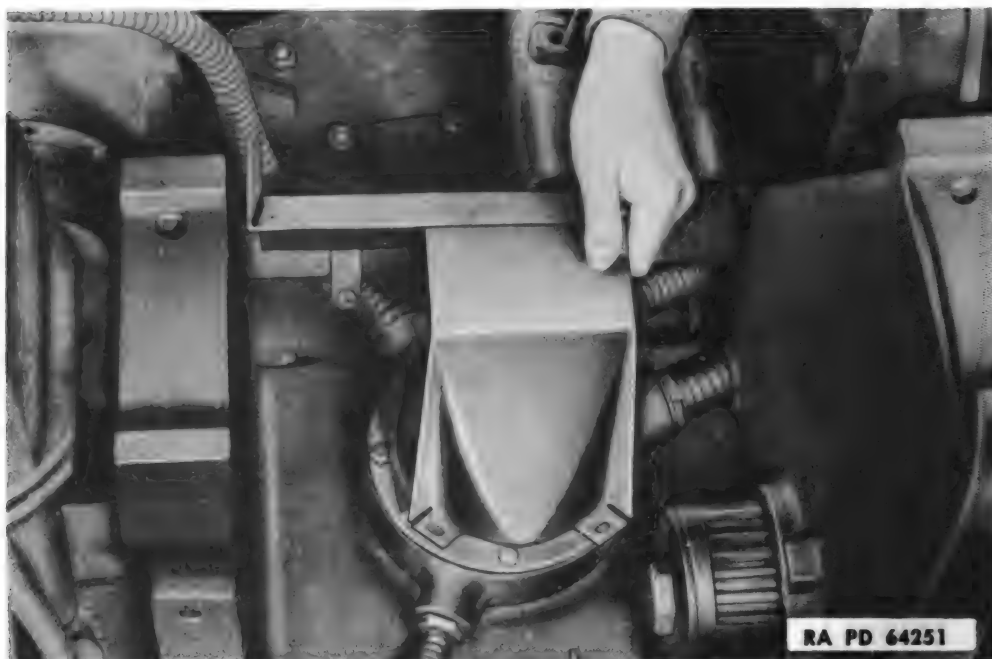


Figure 118—Removing Cartridge Case Deflector

(2) Install traversing rack, positioning marks accordingly, installing the 12 bolts and nuts.

(3) Rig top carriage so top carriage is exactly level, and lower slowly to lower carriage, making certain that the leveling socket collar is below opening in bottom of top carriage, and guide the contact ring cable through opening in leveling socket collar.

(4) Lower top carriage in position and install the 22 screws, lock washers, and nuts, as described in paragraph 44 c, making certain shims are correctly positioned on top carriage clip, and that all wires used to retain shims have been removed.

(5) Install foot firing mechanism housing to top carriage as described in paragraph 38 e.

(6) Install elevating mechanism on carriage as described in paragraph 41 e.

(7) Install traversing mechanism on carriage as described in paragraph 43 e.

(8) Place elevation oil gear on bracket, and attach wires to terminal posts as indicated by marking on wires, to the synchro-differential and synchro-transmitter. Replace side plate cover, and secure with six nuts.

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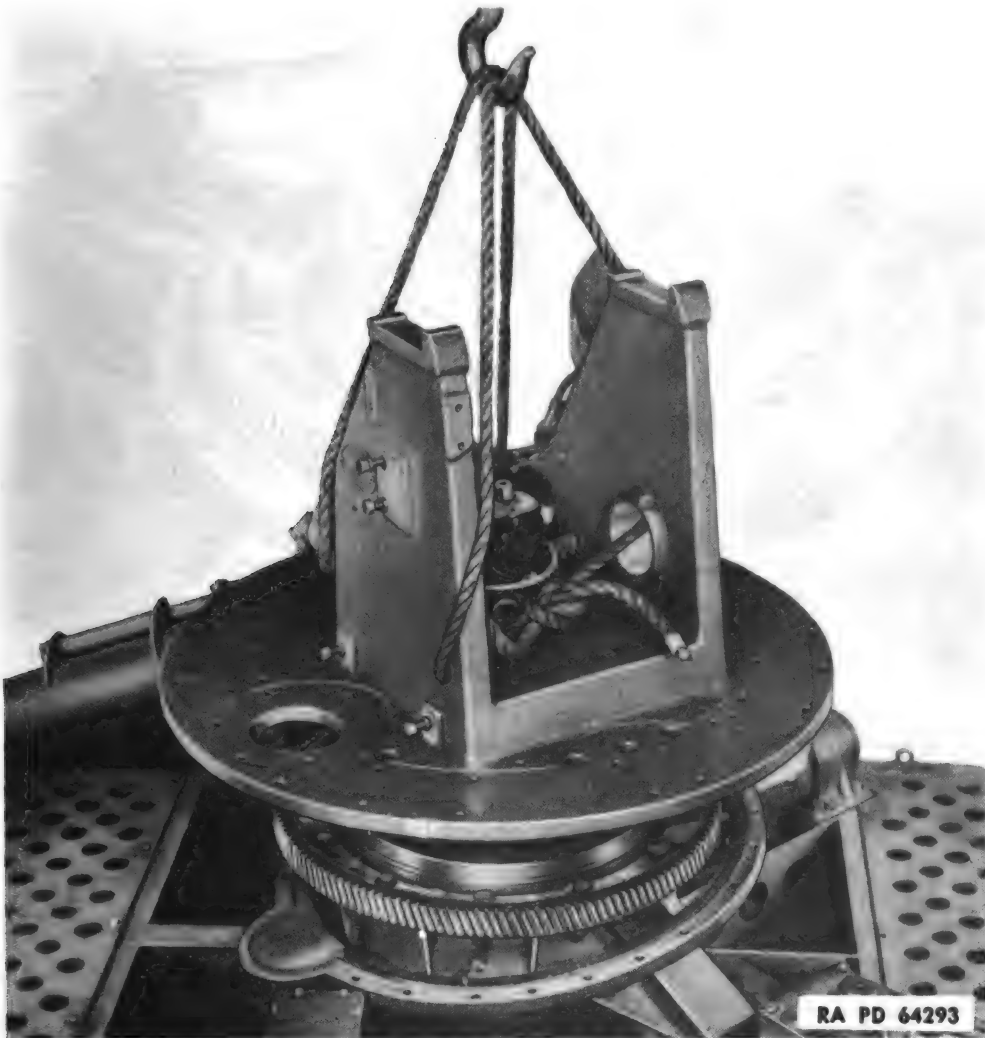


Figure 119—Lifting Top Carriage

(9) Install conduit junction box, securing with three screws, and replace junction box cover, installing three screws. Use small screwdriver for both operations.

(10) Connect wires to terminal posts on oil gear motor terminal block, as indicated by markings on wires, install cover, securing with six nuts, and replace conduit to terminal block by installing four screws.

(11) Assemble oil gear coupling by replacing center spring and rubber seal.

(12) Slide elevation oil gear forward, and engage hydraulic shaft in oil gear coupling.



Figure 120—Removing Traversing Thrust Bearing Assembly

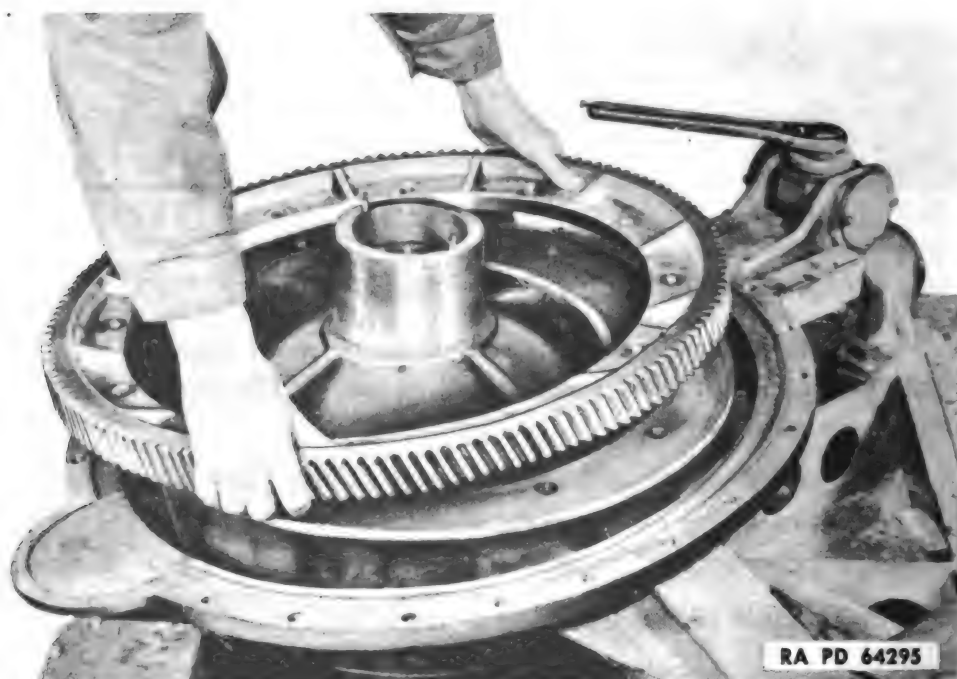


Figure 121—Removing Traversing Rack

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(13) Secure elevation oil gear to bracket by installing four screws, lock washers, and nuts.

(14) Secure oil elevation gear to top carriage brace by installing screw, washer, and nut.

(15) Place azimuth oil gear on bracket, assemble oil gear coupling as outlined for elevation oil gear, engaging hydraulic shaft with the coupling, and securing oil gear to bracket with four screws, lock washers, and nuts.

(16) Secure azimuth oil gear to top carriage brace, installing screw, washer, and nut.

(17) Connect wires to azimuth oil gear synchro-transmitter and synchro-differential, install conduit junction box, replace wires to motor terminal block, replace conduit on motor terminal block, and replace covers as outlined for elevation oil gear.

(18) Install azimuth switch by installing four screws, washers, and nuts. Replace conduit on azimuth switch, installing four screws.

(19) Install elevation limit switch, securing with two screws, and replace conduit on switch, securing with four screws.

(20) Install hydraulic gear switch assembly as described in paragraph 39 e.

(21) Install foot firing mechanism as described in 38 e.

(22) Install platform assembly as described in paragraph 36 d.

(23) Replace contact ring cap and cartridge case deflector. Install conduit on contact ring cable and plate on bottom of chassis; then attach wires to terminal post in gun junction box, and replace cover, as outlined in paragraphs 44 b and c.

(24) Install cradle as described in paragraph 35 f.

(25) Install equilibrator as described in paragraph 34 b.

(26) Install gun in cradle.

(27) Install direct fire sights.

(28) Install foot firing rest pedals and foot firing cable pedals, and secure with taper pin in each assembly.

45. LEVELING MECHANISM, M3 AND M3E1 CARRIAGES.

a. Replacement of Parts. If given proper care, the leveling mechanism should remain in good working condition for the life of the carriage. Severe shock or maltreatment of the mechanism, however, may cause excessive wear, corrosion, or rusting of the bearing surfaces. Backlash or binding indicate that repair or replacement of parts is necessary.

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b. Disassembly. Remove the 360-degree drive mechanism and the top carriage and proceed as follows:

Part	Means of Support	Method of Removal
Two level vials C8283.	Studs A146909, A146910, and A146911; nuts BBAX1E and washers BECX1M.	Remove nuts and washers securing vial assembly to studs and remove vial assembly.
Two studs A146911.	Screwed into yoke D26781.	Unscrew.
Studs A146910 and A146909.	Locked in yoke by nut BBAX1E and washers BECX1M.	Remove nuts and washers and pull out studs.
Nipple A146655 and fitting CLDXLB.	Screwed into socket D26782.	Unscrew.
Nipple A146655 and vent A146992.	Screwed into socket D26782.	Unscrew.
Rack C53647.	Twelve screws A146669, washers BECX1P, and nuts A146668.	Remove screws, nuts, and washers.
Bearing C8751.	Forced on to socket D26782.	Force out.
Handwheels C53634.	Forced on screw C53490 and pin CFCX1CF.	Remove pin and force from screw.
Cover M127738.	Five screws BCFX2FM and washer BECX1K.	Remove screws and washers.
Cap A146660.	Threaded into swivel B127735 and locked with screw A147984.	Remove lock screw and unscrew cap.
Screws C53490 and bearings A146663.	Forced into place.	Unscrew and force bearing out with screw.
Bearings A146663.	Forced and locked to screws C53490 with nut BBRX1AG and washers BEFX1AG.	Remove nut and washer and force bearing from screw using equal pressure all around the bearing.
Support C53488 with bearing A146664 and cover A146665.	Four screws BCAX1ED and washers BECX1M forced on swivel B127735.	Remove screws and washers and pull from swivel.
Covers A146665.	Four screws BFCX2DG and washers BECX1G.	Remove screws and washers.
Swivel B127735 and cover C53640.	Secured in bearing A146664 and twelve screws BCKX3EE.	Remove screws from cover and drive swivel out of bearing.
Bracket C53497, enclosed housing C53496, and nut B127746.	Four screws BCAX2AC and washers BECX1P.	Remove screws and washers.

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Part	Means of Support	Method of Removal
Nut B127746.	Secured in bearing A 1 4 6 6 8 8, nuts B B R X 1 A F and washers B E F X 1 A F.	Remove nuts and washers and drive out of housing.
Housing C53496.	Secured in bearings A146686 and A146687, cover A146685, pin B F A X 2 A C, and nut B B F X 3 B.	Remove pin, nut, washer, and cover and drive out.
Bearing A146686.	Secured in housing C53496 or bracket C53497.	Pull from housing or drive out of bracket.
Bearings A146688.	Secured in bracket C53497 or on nut B127746.	Pull from nut or drive out of bracket.
Bearings A146664.	One secured in support C53488 and in yoke D26781.	Force out using equal pressure all around bearings.
Cover C53495.	Twelve screws B C K X 2 A C.	Remove screws.
Cover B127745.	Six screws B C K X 2 A C.	Remove screws.
Oil cup, C L F X 2 H.	Screwed into case D26783.	Unscrew.
Case 426783.	Four bolts A147056, nuts B B A X 2 B, and washers B E C X 1 P.	Remove screws, nuts, and washers.
Nut C53492.	Five screws B C K X 2 A C through shield and secured on bearing A146637.	Remove screws and drive nut from bearing.
Bearing A146637 and shield B127743.	Secured on stud B127744 in yoke D26781 and locked with nut B B R X 1 A K and washers B E F X 1 A K.	Remove nut and washer and pull from stud.
Clamp D41724.	Locked in socket D26782 with nut A147344, screw B C C X 1 B B, and key B G B X 2.	Remove screw, nut, and pull clamp down out of socket. Remove the key.
Socket D26782 and yoke D26781 shrunk together.	Rests on bearing C53487.	Lift off.
Bearing C53487.	Eight screws B C A X 2 A C and washers B E C X 1 P.	Remove screws and washers.

c. **Assembly.** When assembling the leveling mechanism and top carriage to the chassis, it will be necessary to observe the following general procedures:

- (1) The chassis should be maintained level during the assembly.

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(2) Socket D26782 and yoke D26781 should be placed on bearing C53487 so they will be level. This can be determined by placing two levels at right angles to each other on the socket.

(3) Assemble screws C53490 to the mechanism so that as much of the threads are above the nuts as below the nuts.

(4) Clean and lubricate bearing C53487, socket D26782, and rack C53647 before assembly.

(5) After assembly, adjust the level vial bubbles as described in paragraph 47 e.

(6) Lubricate as specified in paragraph 58.

46. LEVELING MECHANISM, M3A1 CARRIAGE.**a. Removal.**

(1) Remove gun from cradle.

(2) Remove cradle as described in paragraph 35 b.

(3) Disconnect male contact ring and cable.

(4) Remove top carriage as described in paragraph 44 b.

(5) Remove traversing thrust bearings, traversing rack, and top carriage clip, as described in paragraph 44 d.

(6) Remove screw BCCX1BB from leveling socket clamp nut A147344.

(7) Remove leveling socket clamp nut A147344, making sure to hold clamp from underneath chassis to hold leveling socket clamp D42262 as nut is removed, to avoid clamp falling to ground. Remove key BGBX2.

(8) Remove four bolts A147056, nuts BBAX2B, and lock washers BECX1P, from base of leveling jack, right, using a $\frac{7}{8}$ -inch wrench on the bolt, and a 1-inch wrench on the nut.

(9) Remove four screws BCAX2AC and lock washers BECX1P from base of leveling jack, left, using a $\frac{7}{8}$ -inch wrench.

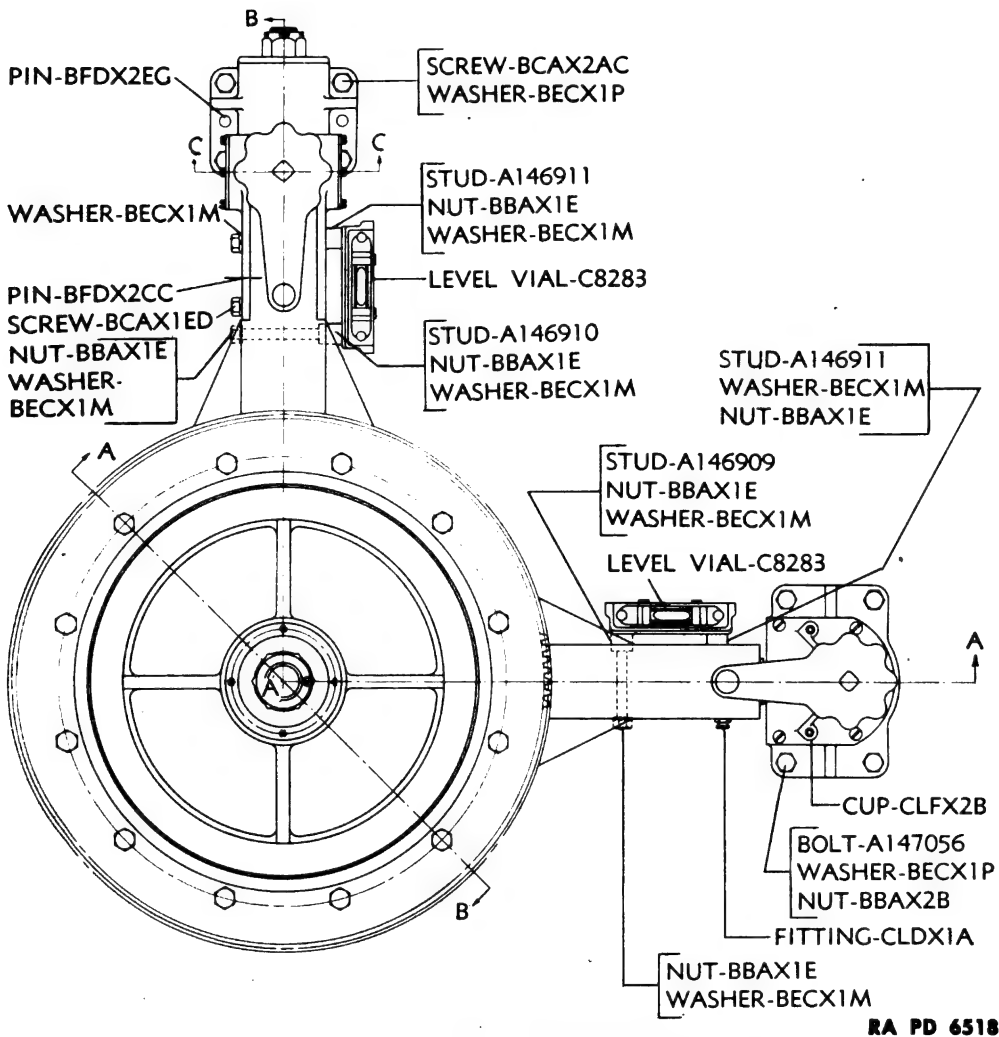
(10) Remove two pins BFDX2EG from base of leveling jack, left, using brass drift.

NOTE: If unable to drift out pins BFDX2EG, place wood blocks on lower section of chassis, underneath leg extending from leveling yoke, and work ratchet handle as if to lower. The leg pressing into wood blocks will raise jack from lower carriage.

(11) Rig leveling mechanism and lift from lower carriage with chain hoist or other suitable means.

(12) Remove leveling socket bearing C53487 from lower carriage by removing eight screws BCAX2AC and lock washers BECX1P.

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Figure 122—Leveling Mechanism Assembly—Section

b. Disassembly.

(1) DISASSEMBLE LEVELING JACK, RIGHT.

(a) Remove screw BCDX2AA and washer A217824 from top of ratchet wrench A217826 and lift off wrench.

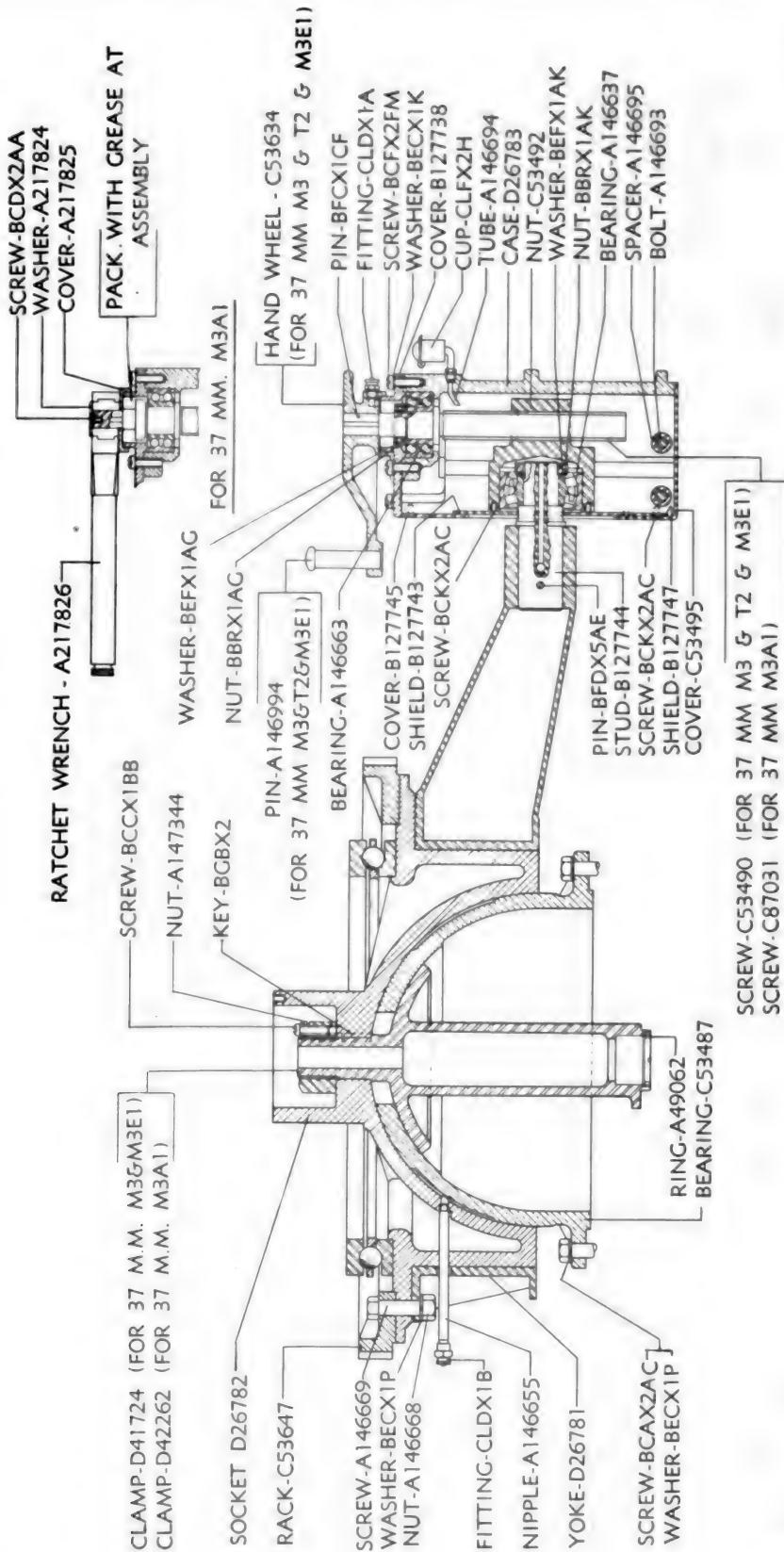
(b) Lift off leveling screw cover A217825.

(c) Remove leveling case upper cover B127738, using heavy-duty screwdriver, and remove six fillister-head screws BCFX2FM and lock washers BECX1K.

(d) Remove nut BBRX1AG and washer BEFX1AG from upper end of leveling screw C87031.

(e) Remove leveling case cover B127745, upper and lower, by removing 12 flat-head screws, using small screwdriver.

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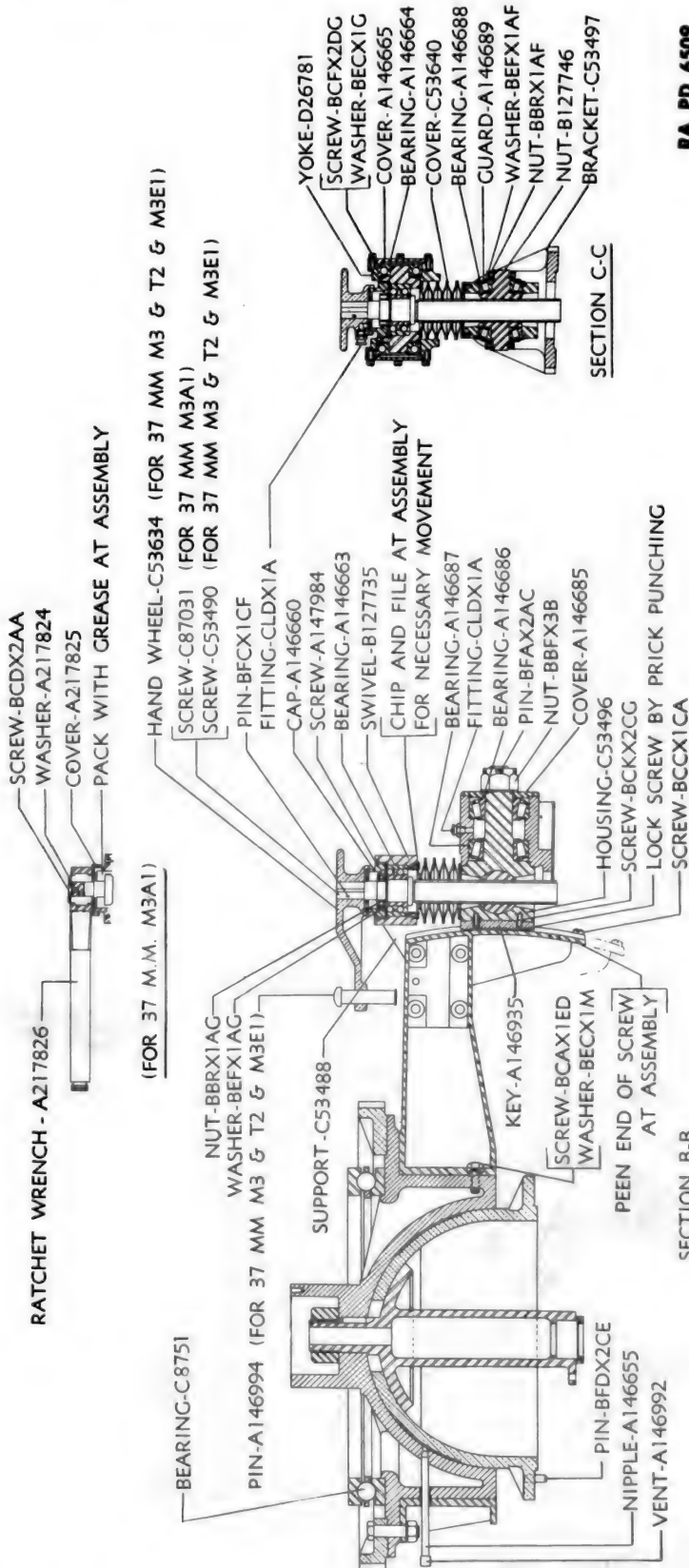


RA PD 6519

SECTION A-A

Figure 123—Leveling Mechanism—Section A-A

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Figure 124—Leveling Mechanism—Section B-B and C-C

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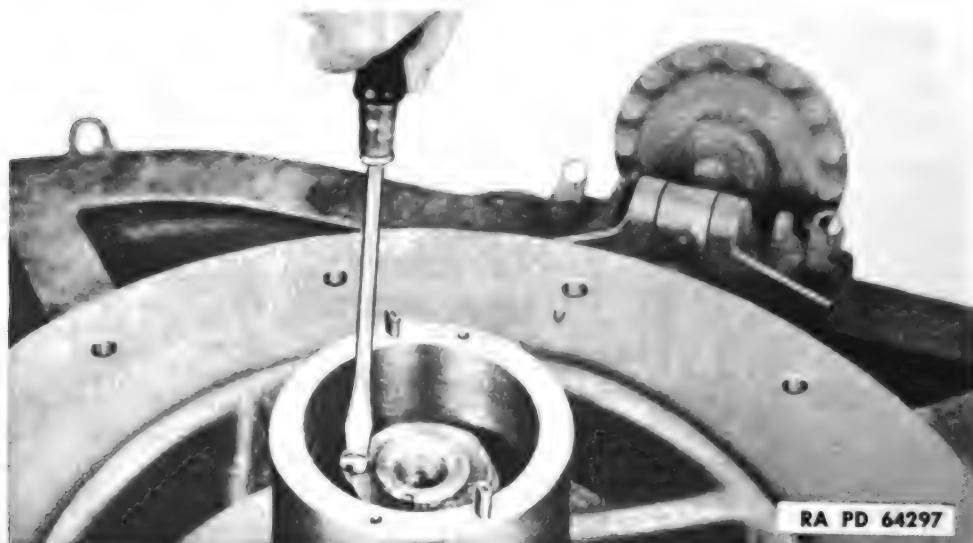


Figure 125—Removing Leveling Socket Clamp Nut Screw

(f) Remove leveling case upper shield B127743 and leveling case lower shield B127747 by removing ten flat-head screws, using small screwdriver.

(g) Remove leveling case lower cover C53495 by removing six flat-head screws, using small screwdriver.

NOTE: The following operations on leveling jack, right, can be done with unit on bench, inasmuch as removal of leveling case shields will permit removal of jack assembly from leveling yoke.



Figure 126—Removing Screws from Leveling Jack, Right, from Lower Carriage

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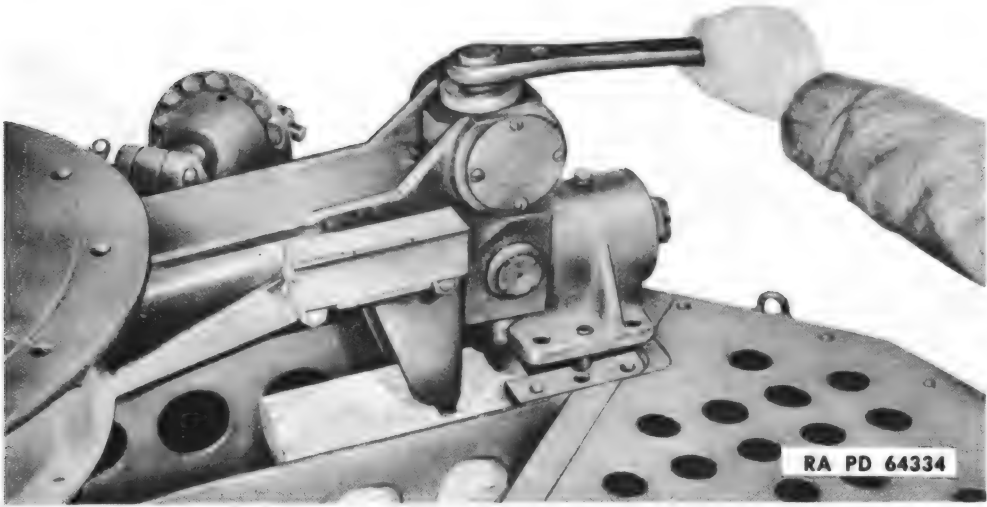


Figure 127—Lifting Leveling Jack, Left, from Lower Carriage

(h) Use a heavy-duty screwdriver and remove leveling case bolts A146693 and spacers A146695.

(i) Remove leveling screw C87031 from leveling screw nut C53492 by using ratchet wrench A217826, turning in counterclockwise direction, and slide leveling screw nuts from leveling case.

(j) Remove leveling screw C87031 and leveling screw bearing A146663 from leveling case D26783 by pressing on outer race of bear-

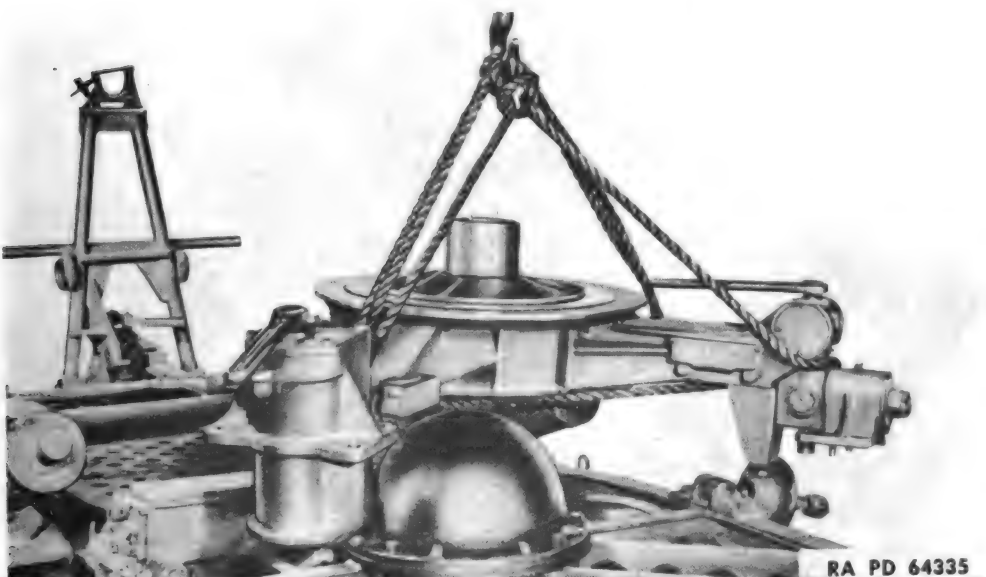


Figure 128—Lifting Leveling Mechanism from Lower Carriage

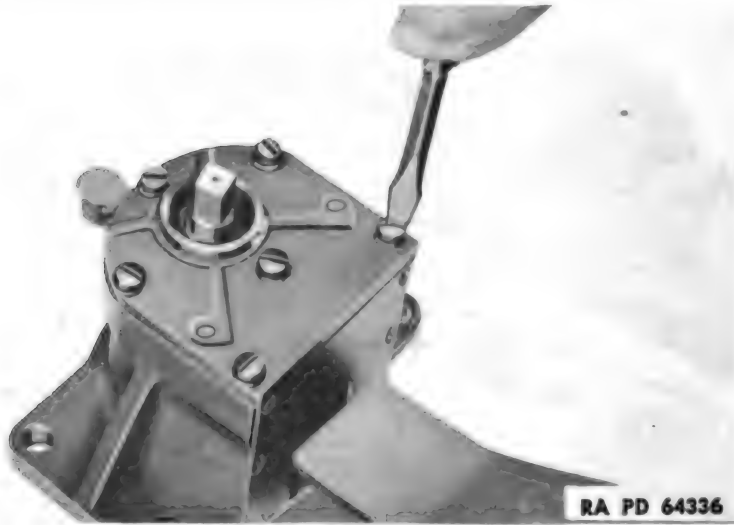


Figure 129—Removing Leveling Case Upper Cover

ing. In the absence of a press, a brass drift may be used on outer race of bearing. Remove leveling screw bearing from leveling screw by pressing on inner race of bearing.

(k) Remove lock nut BBRX1AK and washer BEFX1AK from leveling yoke bearing, using a gear puller or other suitable means. (Bearing should not be removed unless new bearing is to be installed as bearing may be damaged in removal.)

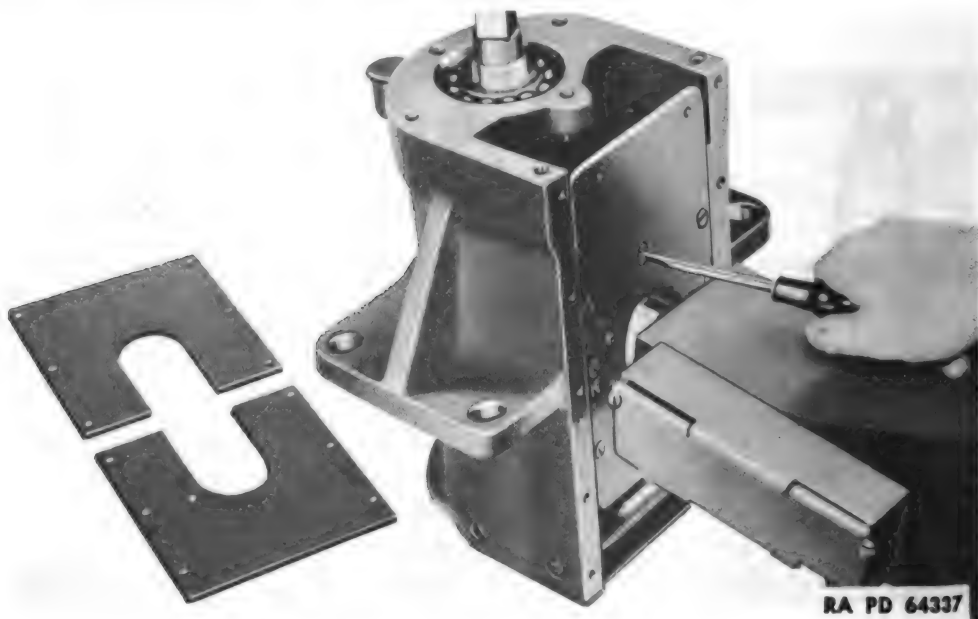


Figure 130—Removing Leveling Case Shields

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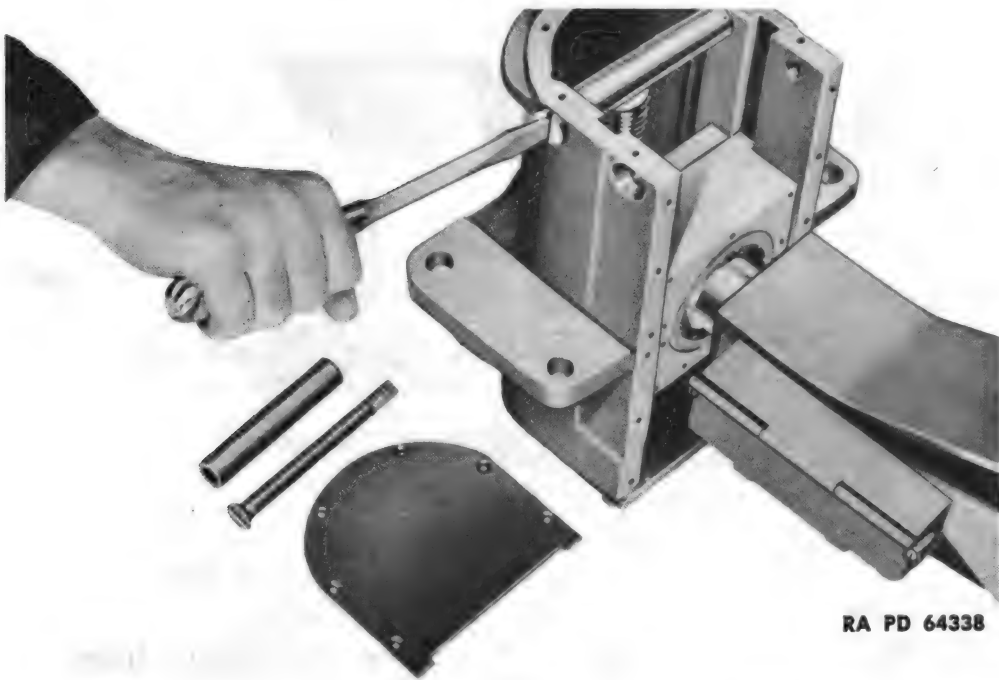


Figure 131—Removing Leveling Case Bolts and Spacers

- (2) **INSPECT LEVELING JACK, RIGHT.**
- (a) Clean and lubricate all parts.
 - (b) Inspect all bearings for roughness.
 - (c) Check operation of ratchet wrenches.
 - (d) Examine leveling screws for worn or damaged threads.

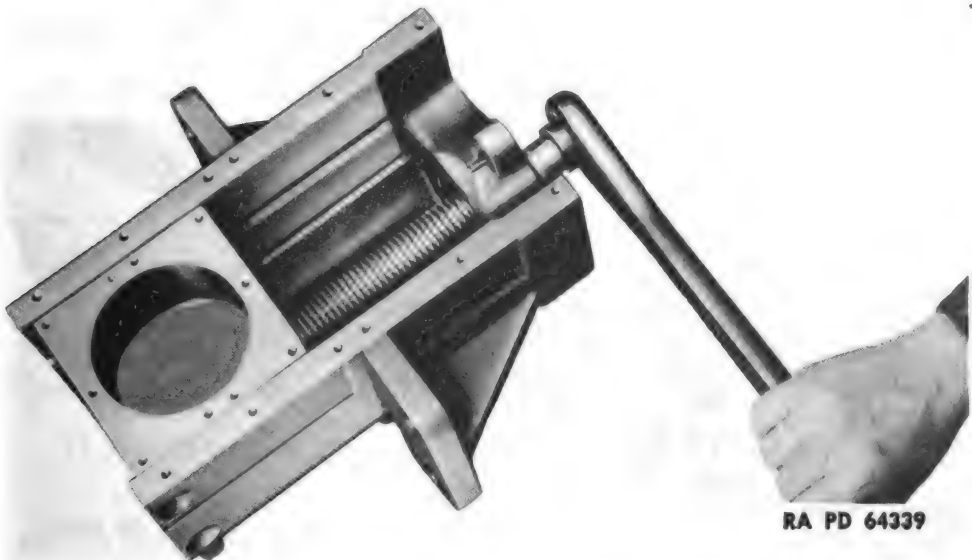
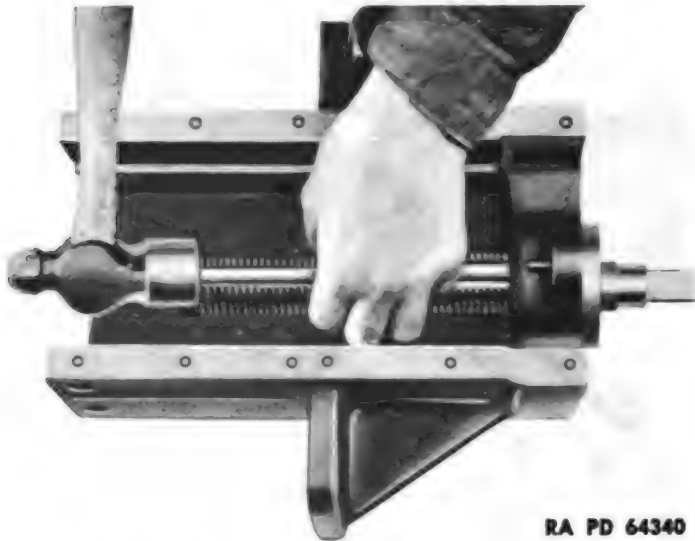


Figure 132—Removing Leveling Screw from Leveling Screw Case



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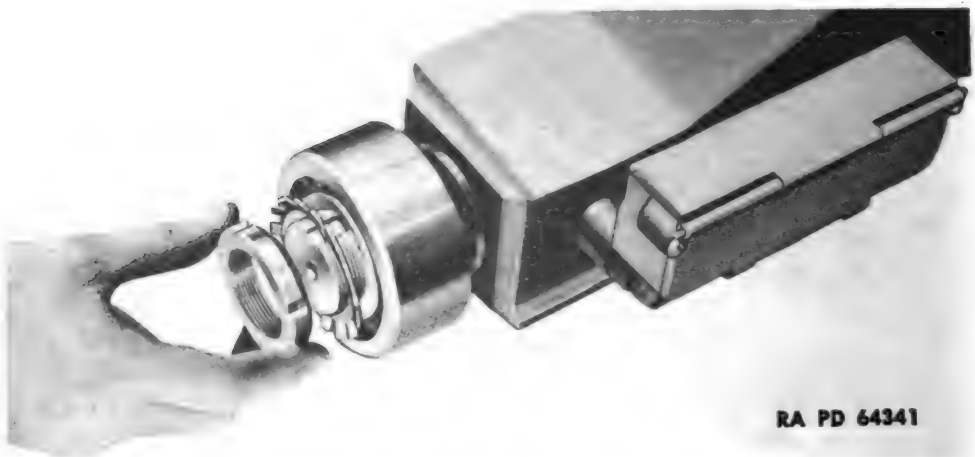
Figure 133—Removing Leveling Screw and Bearing from Leveling Case

(3) ASSEMBLE LEVELING JACK, RIGHT.

(a) Install new leveling yoke bearing on leveling yoke, and install washer and lock nut, if damaged bearing was removed.

(b) Press leveling screw bearing on to leveling screw, exerting pressure on inner race.

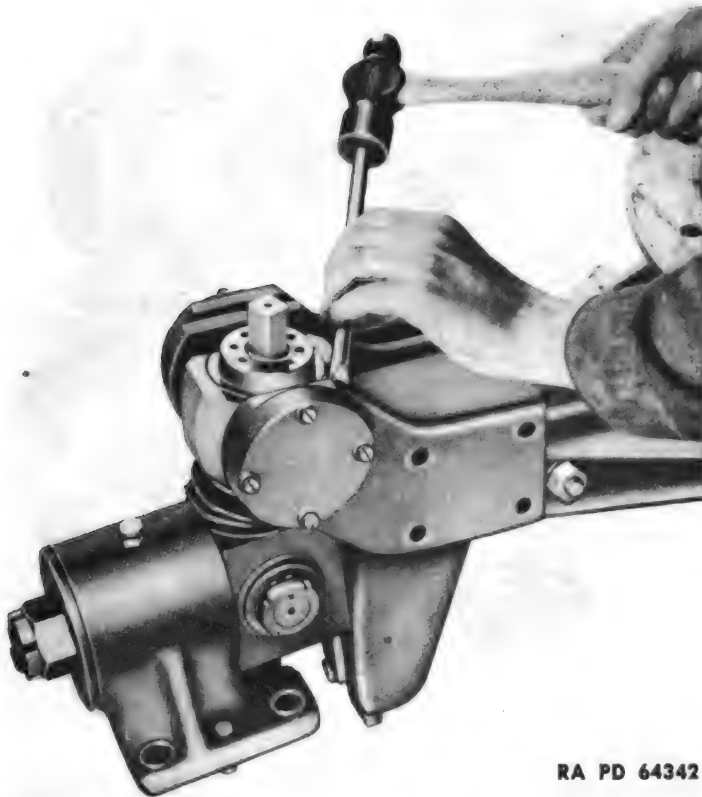
(c) Press leveling screw and bearing into case. Position leveling screw nut in leveling case, and thread leveling screw through leveling screw nut by using ratchet wrench, turning in clockwise direction.



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Figure 134—Removing Lock Nut from Leveling Yoke Bearing

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Figure 135—Removing Leveling Bearing Support

(d) Position each leveling case spacer in leveling case, and install each leveling case spacer bolt through case and spacer, using heavy-duty screwdriver.

(e) Attach lower cover to case with six flat-head screws, using a small screwdriver.

(f) Install leveling case on leveling yoke bearing, positioning bearing in leveling screw nut.

(g) Attach leveling case upper shield, and leveling case lower shield to case with ten flat-head screws, using a small screwdriver.

(h) Replace leveling case cover B127745, upper and lower; secure with ten flat-head screws, using a small screwdriver.

(i) Install washer and nut on leveling screw.

(j) Install leveling case upper cover B127738 with six lock washers, and six fillister-head screws, using heavy-duty screwdriver.

(k) Install leveling screw cover and install ratchet wrench, securing to leveling screw with washer and small screw.



Figure 136—Removing Swivel of Leveling Jack from Bearing

(4) DISASSEMBLE LEVELING JACK, LEFT.

(a) Remove screw and washer from ratchet wrench A217826 and lift off wrench.

(b) Remove leveling screw cover A217825.

(c) Remove four screws from leveling bearing support C53488, using a $\frac{3}{4}$ -inch wrench, and remove support by using brass drift, applying force against inner side of the support.

(d) Remove the leveling swivel yoke cover A146665 from stationary bearing support by removing four fillister-head screws, using a small screwdriver.

(e) Press the swivel of leveling jack out of bearing in stationary bearing support with gear puller or other suitable tool.

NOTE: If bearings A146664 in stationary bearing support and leveling bearing support are serviceable, do not remove them as damage to bearings may result.

NOTE: Balance of disassembly operations can be performed with unit on bench.

(f) Remove the bearing lock nut BBRX1AF, washer BEFX1AF, and swivel nut bearing dust guard A146689 from each side of leveling swivel nut housing.

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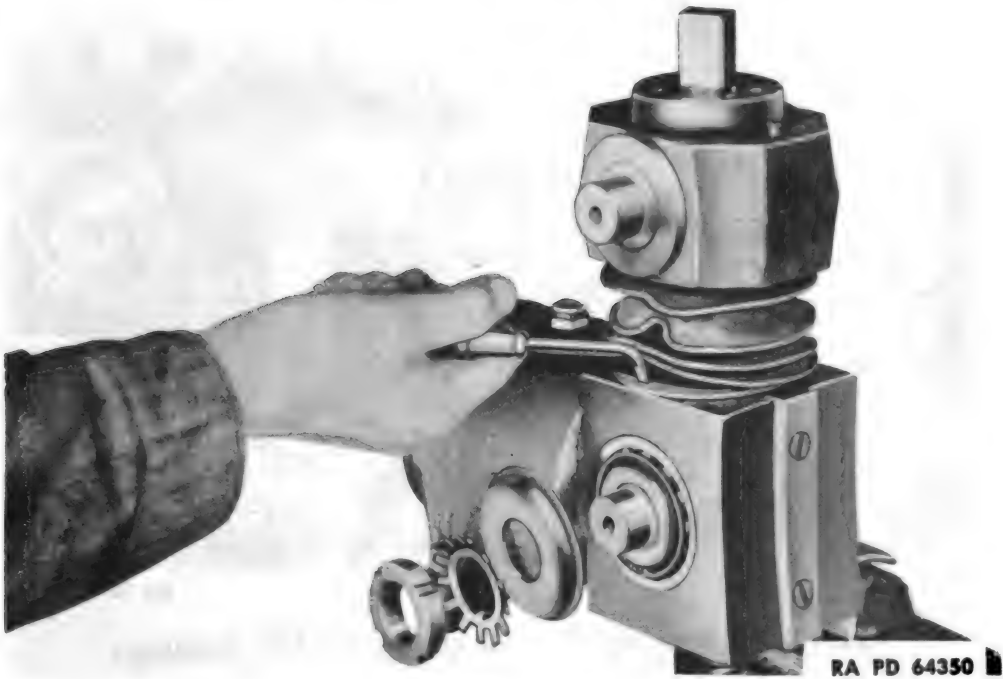


Figure 137—Disconnecting Leveling Mechanism Cover



Figure 138—Removing Leveling Screw from Swivel Nut Housing



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Figure 139—Removing Nut from Swivel Nut Housing

(g) Disconnect leveling mechanism cover C53640 by removing six screws from swivel nut housing. Use a small offset screwdriver.

(h) Remove leveling screw C87031 from leveling swivel nut housing by using a ratchet wrench, turning in counterclockwise direction.

(i) Remove cotter pin BFAX2AC and nut BBFX2B from leveling swivel nut housing cover A146685, and remove cover.

(j) Remove swivel nut housing C53496 from leveling swivel nut housing bracket C53497 by use of arbor press or other suitable means.

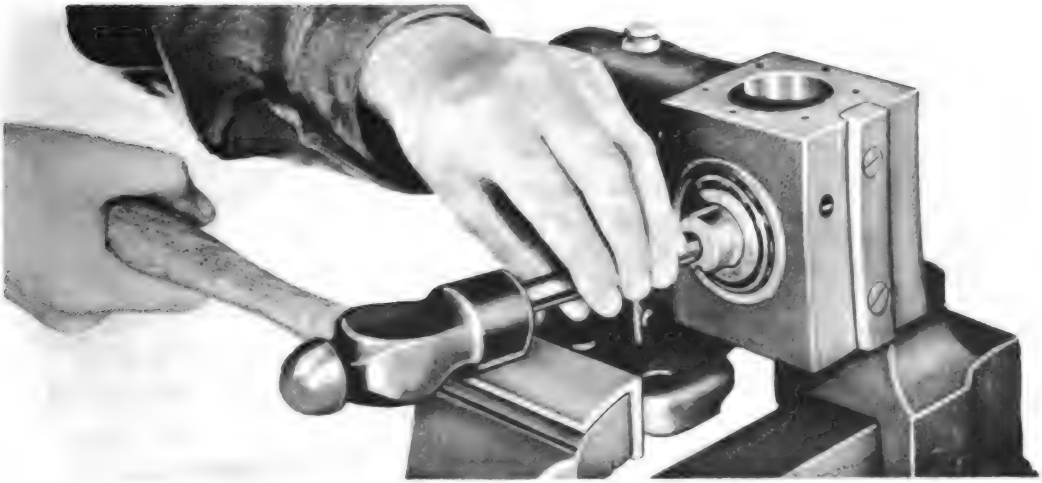
CAUTION: Unless bearings in swivel nut housing, swivel nut housing



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Figure 140—Removing Swivel Nut Housing from Bracket

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Figure 141—Removing Bearings in Swivel Nut Housing

bracket, and swivel are damaged, it is not advisable to remove the bearings, as considerable force must be exerted for removal, and damage to the bearings may result. If, however, they must be replaced, use an arbor press, gear puller, or remove with brass drift and hammer.

(k) Remove leveling mechanism cover from swivel B127735 by removing six screws with an offset screwdriver.

NOTE: If swivel bearing A146663 is damaged, the following operations are necessary for replacement.

(l) Remove screw A147984 and cap A146660 from swivel B127735, using a spanner wrench.

(m) Remove nut BBRX1AC from leveling screw, using a spanner wrench or brass drift.

(n) Press bearing out of swivel and off leveling screw.

(5) **INSPECT LEVELING JACK, LEFT.**

(a) Clean all parts.

(b) Inspect bearings for roughness.

(c) Check operation of ratchet wrenches.

(d) Examine leveling screws for worn or damaged threads.

(e) Lubricate all parts prior to assembly.



Figure 142—Removing Nut from Leveling Screw

(6) ASSEMBLE LEVELING JACK, LEFT.

(a) Press bearing A146663 on leveling screw and press bearing and screw into swivel.

(b) Install lock washer BEFX1AC and nut BBRX1AC on screw and lock in place.

(c) Pack cap A146660 with GREASE, O. D. (seasonal grade), and tighten in swivel with suitable spanner wrench, locking in place with screw A147984.

(d) Fasten cover C53640 to bottom of swivel with six screws.

(e) Position the swivel nut in the swivel nut housing and press bearings A146688 into place. Replace dust guards, lock washers, and lock nuts.

(f) Assemble bearing A146687 to shaft of swivel nut housing and press this assembly into bracket C53497. Press bearing A146686 into bracket and on outer end of swivel nut housing shaft.

(g) Install cover A146685 on shaft of swivel nut housing and install nut and lock with cotter pin.

(h) Thread leveling screw into swivel nut housing, using a ratchet wrench and turning in clockwise direction.

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(i) Fasten cover C53640 to swivel nut housing with six screws, using an offset screwdriver.

(j) If bearings A146664 have been removed from the stationary bearing support or the leveling bearing support, replace with new bearings.

(k) Aline stub shaft of leveling jack swivel with bearing in stationary bearing support and press into place.

(l) Drive out dowel pin so that inner end is flush with inner face of leveling bearing support. Press bearing support in place on stub shaft of leveling jack swivel and drive dowel pin in place.

(m) Secure bearing support to yoke with four lock washers and cap screws, using a $\frac{3}{4}$ -inch wrench.

(n) Install leveling swivel yoke cover A146665 and secure with four fillister-head cap screws.

(o) Place cover A217825 on leveling screw, and install ratchet wrench, washer, and screw.

c. Installation.

(1) Install leveling socket bearing C53487 to lower carriage, securing with screws BCAX2AC and lock washers BECX1P. Coat socket bearing liberally with GREASE, O. D. (seasonal grade).

(2) Rig the leveling mechanism assembly and install on leveling socket bearing and lower carriage.

(3) Position the left leveling jack on the lower carriage and drive dowel pins in place. Secure the leveling jack to lower carriage with four lock washers BECX1P and screws BCAX2AC, using a $\frac{7}{8}$ -inch wrench.

(4) Fasten the right leveling jack to the lower carriage with four bolts A147056, lock washers BECX1P, and nuts BBAX2B, using a $\frac{7}{8}$ -inch wrench on bolt heads and a 1-inch wrench on nuts.

(5) Install leveling socket clamp D42262 from under chassis. Install key BGBX2 and install nut A147344 and setscrew BCCX1BB.

(6) Install top carriage clip, traversing rack, and traversing thrust bearings as described in paragraph 44 c.

(7) Install top carriage as described in paragraph 44 e.

(8) Connect male contact ring and cable.

(9) Install cradle as described in paragraph 35 f.

(10) Install gun in cradle.

47. LEVEL VIAL WITH CASE ASSEMBLY.

NOTE: Two leveling vials are provided with each leveling mechanism. Each vial is protected from damage by a leveling vial case which is secured to the leveling yoke adjacent to each leveling jack.



Figure 143—Leveling Vial and Case Assembly

a. Removal. Remove the two nuts and lock washers that hold the leveling vial case on the mounting studs. Use a $1\frac{3}{16}$ -inch wrench.

b. Disassembly.

(1) The side of the leveling case may be opened by removing two round-head screws with a screwdriver. This will permit easy access to vial adjusting and retaining studs and nuts.

(2) The vial is removed by removing a thumb nut at each end of the vial.

c. Inspection. Visual inspection can be given the leveling vial by lifting cover. Cleaning of vial glass and interior of case may be accomplished by removing two round-head screws and dropping the side of the case.

(1) Inspect the vial glass for cracks or loss of fluid. If leakage has occurred, the vial must be replaced.

(2) Inspection of leveling vial for proper functioning is the same as given in subparagraph e below.

d. Assembly. Install leveling vial on studs in case and tighten thumb screws with fingers. If a tool is used, avoid severe tightening.

e. Adjustment.

(1) Set the gun in firing position on smooth, hard, level ground.

(2) Traverse the top carriage until the gun tube is over one of the leveling jacks.

(3) Level the top carriage by means of both leveling screws.

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(4) Insert a clinometer in the muzzle of the gun and elevate or depress the gun until the clinometer bubble is centered.

(5) Traverse the gun until it points in the opposite direction and check the reading of the clinometer.

(6) If the clinometer is not level, adjust the elevation of the gun by means of the elevating hand crank so as to bring the clinometer bubble halfway back to the center point. Then adjust the leveling screw behind the gun until the clinometer bubble is centered.

(7) Traverse the gun back to its original position and note the position of the clinometer bubble.

(8) If it is not centered, adjust the elevation of the gun by means of the elevating hand crank so as to bring the clinometer bubble halfway back to the center point. Adjust the leveling screw below the gun tube until the clinometer bubble is centered. Traverse the top carriage so that the gun points in the opposite direction and note the position of the clinometer bubble. Repeat as described in steps (6) and (7) above if the bubble is not centered.

(9) The adjustment is concluded when the clinometer bubble remains level while the gun is over the leveling jack, and also opposite the leveling jack. The bubble of this leveling jack should then be adjusted to center the bubble. This can be done by removing the top of the level vial container and raising or lowering one end of the vial by means of the nuts and stud supporting it.

(10) Repeat this procedure for the second leveling jack.

(11) When both leveling jack bubbles have been adjusted in this manner, the clinometer in the muzzle of the gun should remain centered as the gun carriage is traversed through 360 degrees.

(12) If the level vial bubbles do not deviate more than one division from the center, the gun is considered level.

48. CARRIAGE BUFFER MECHANISM.

a. Removal.

(1) Place carriage in firing position.

NOTE: The following operation (fig. 145) is only necessary when removing the front (right) buffer assembly.

(2) Remove cotter pin from buffer link end pin A147089 which connects front buffer link A147090 and front buffer extension lever B160261, and remove the pin.

(3) Remove two cap screws A148558, nuts BBBX1E, and lock washers from buffer cylinder bearing C53569, using a $\frac{3}{4}$ -inch wrench on the head and a $\frac{13}{16}$ -inch wrench on the nut.

(4) Remove four cap screws and lock washers, which secure buffer

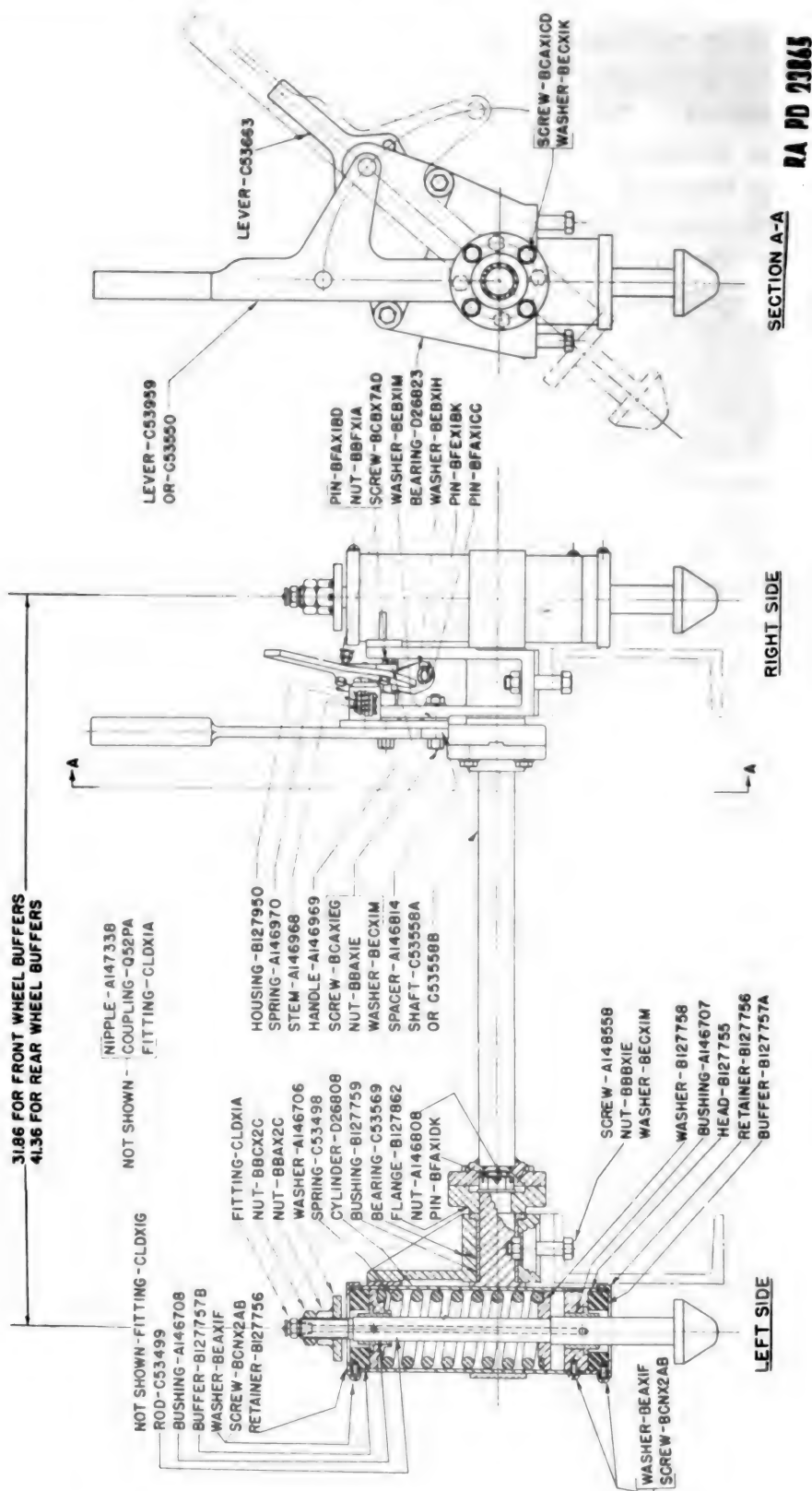


Figure 144—Carriage Buffer Mechanism

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Figure 145—Removing Front Buffer Link End Pin

shaft flange B127862 to buffer cylinder bearing, from buffer shaft C53558A.

(5) Remove cotter pin from buffer cylinder shaft, and remove buffer cylinder stud nut A146808. Remove buffer cylinder flange B127862.

(6) Remove buffer unit from buffer cylinder bearing by withdrawing shaft from bearing.

b. Disassembly. It is necessary to remove buffer assembly in order to disassemble it.

(1) Remove buffer cylinder as described in paragraph 60 a.

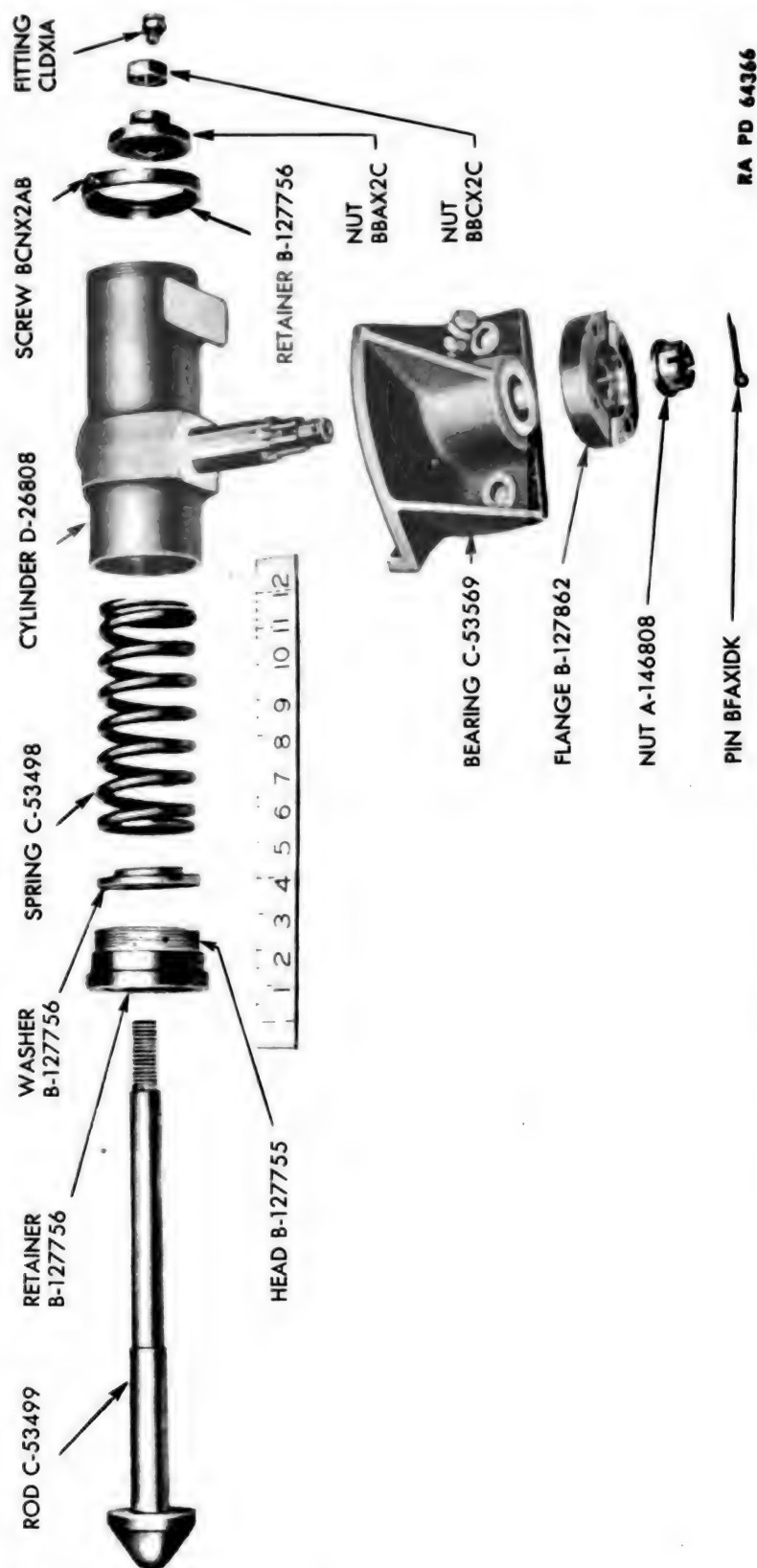
(2) Remove lubrication fitting CLDX1A and nut BBCACC, located on top end of buffer cylinder plunger rod C53499.

(3) Remove the upper of the two screws BCNX2AB and washers BEAC1F in the lower end of the cylinder and unscrew the head B127755, in which are secured the lower retainer B127756, buffer, and bushing A146707.

(4) Unscrew the retaining nut of the buffer rod. As this nut is released, the spring expands and will push the rod and washer B127758 out of bottom of cylinder. If this does not occur, tap the rod down and out of the cylinder. Remove the spring C53498 and washer.

(5) Remove setscrew in upper spring retainer B127756 and unscrew the retainer from cylinder.

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Figure 146—Carriage Buffer Assembly—Exploded View

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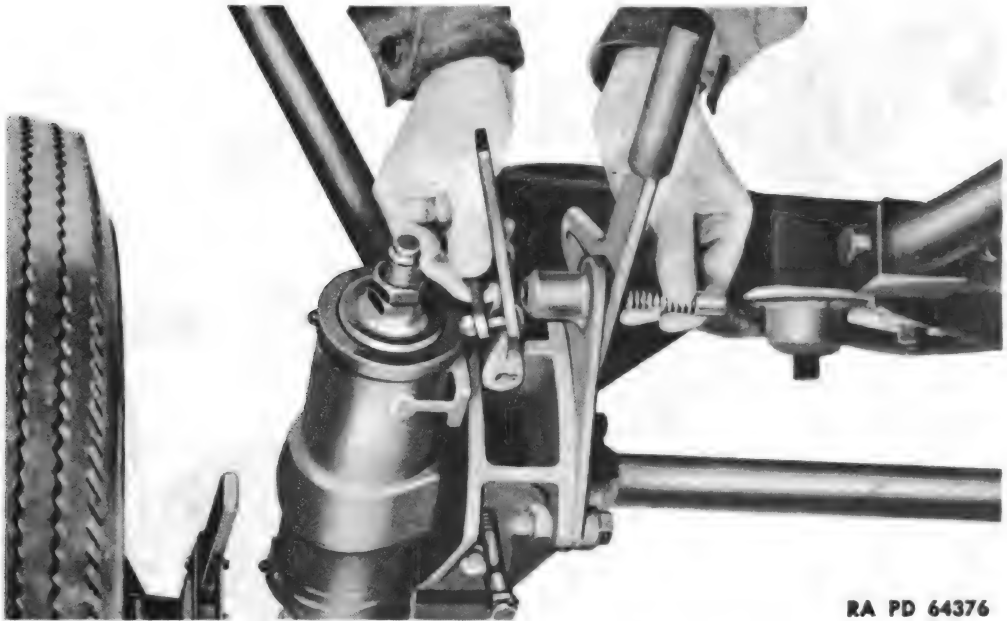


Figure 147—Inspecting Buffer Lock Lever Stem and Spring

c. Inspection.

(1) Examine the buffer spring for cracks and measure the free length of spring, for a spring that has collapsed, or acquired a "set," will not function properly. A new spring measures approximately 6 inches.

(2) Inspect all bushings, upper and lower buffers, and shafts for wear. Replace all worn parts.

(3) Lubricate spring and rod before assembly.

(4) After assembly and installation on carriage, check levers C53959, C53550, and C53663, as well as all connecting stops and pins, to see that they are functioning properly in engagement and release.

(5) Carefully inspect the threads on end of buffer lock lever stem A146968 and make certain that it engages securely in housing B127950. Check the buffer lock lever spring for breakage, or "set." These precautions are important, since the accidental disengagement of a buffer lock lever will cause that section of the carriage to drop and result in injury to personnel and damage to equipment.

(6) Check points on axle arms where buffer rod rests. The amount of wear should be about equal for both rear arms and both front arms.

d. Assembly.

(1) Place head, in which is installed the lower retainer, buffer, and bushing, on the buffer rod. Place washer and spring on buffer cylinder



Figure 148—Removing Dust Guard

plunger rod. Screw the head into the cylinder and install the setscrew in the retainer.

(2) Install retaining nut and locking nut on upper end of rod and screw on the retainer and install setscrew. Install lubrication fitting CLDX1A.

e. Installation.

(1) Install bearing on chassis and secure with two cap screws, lock washers, and nuts, using a $\frac{3}{4}$ -inch wrench on head of cap screw and a $1\frac{3}{16}$ -inch wrench on the nut.

(2) Install cylinder on bearing by thrusting shaft of cylinder through the bearing. Install flange, nut, and cotter pin.

(3) Fit buffer shaft to flange, being careful to index splines of shaft and flange, correctly. Secure with four cap screws, using a $\frac{9}{16}$ -inch wrench.

(4) A slight adjustment of the buffer cylinder plunger rod is possible, by turning the lock nut and retaining nut on top of rod. Tightening the nuts will compress the spring, while loosening them will expand the spring. The maximum adjustment possible is about 1 inch. Operate the buffer mechanism from traveling to firing position and back again. There should be no undue binding of the motion.

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Figure 149—Counterpoise Wrenches

49. COUNTERPOISE ASSEMBLIES.

a. Removal. Each counterpoise assembly can be removed as a unit, but should remain on carriage during disassembly. Rear wheels must be removed when removing rear counterpoise assemblies.

(1) Remove the six screws and lock washers which secure counterpoise dust guard to cover, and remove guard.

(2) Measure the length of, or count the threads of the exposed counterpoise rod C87054 extending from lock nut BBAX2E, and record it, so same adjustment can be made upon reinstallation.



Figure 150—Releasing Tension from Counterpoise Rod

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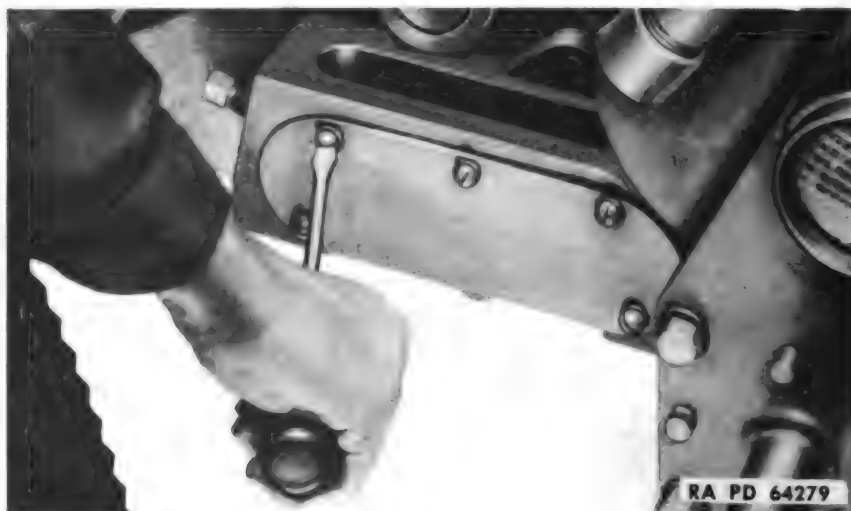


Figure 151—Removing Axle Bracket Cover

(3) Use counterpoise wrenches B161475 and B161476 and back off counterpoise rod lock nut and counterpoise rod nut, until spring pressure is released.

CAUTION: Do not remove the counterpoise cylinder cover B127742 or loosen it, because when counterpoise rod nut is removed the pressure of counterpoise springs will be released against the cover.

(4) Remove the five screws and lock washers securing axle bracket cover and lift off cover.



Figure 152—Removing Setscrew from Counterpoise Trunnion Nut

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Figure 153—Removing Counterpoise Support

(5) Disconnect counterpoise rod from axle bracket by removing the counterpoise rod pin A146680. Use a $\frac{3}{8}$ -16 NC-2 cap screw in threaded hole in end of pin to withdraw pin from rod bearings and eye of counterpoise rod.

CAUTION: Support upper end of cylinder while removing pin to prevent the cylinder from swinging down and injuring personnel.

(6) Lower front end of cylinder, disengaging rod from the two rod bearings A146681 and axle bracket. Remove both rod bearings.

(7) Remove setscrew BCUX1FK from each trunnion stud nut A147005.

NOTE: Make certain the slot in setscrew is clean and free of paint, and that trunnion stud nut has not been moved and is not binding threads of setscrew.

(8) Remove both trunnion stud nuts.

NOTE: Place the nuts back on studs to prevent their becoming interchanged. This is necessary because the threaded hole for setscrew is tapped after nut is first installed.

(9) Remove the four cap screws holding counterpoise supports to chassis frame. Tap the rear face of support with a copper hammer to loosen the four dowel pins; then pry support away from frame. Support must be removed evenly or dowel pins will become bent.

(10) Remove counterpoise cylinder assembly.

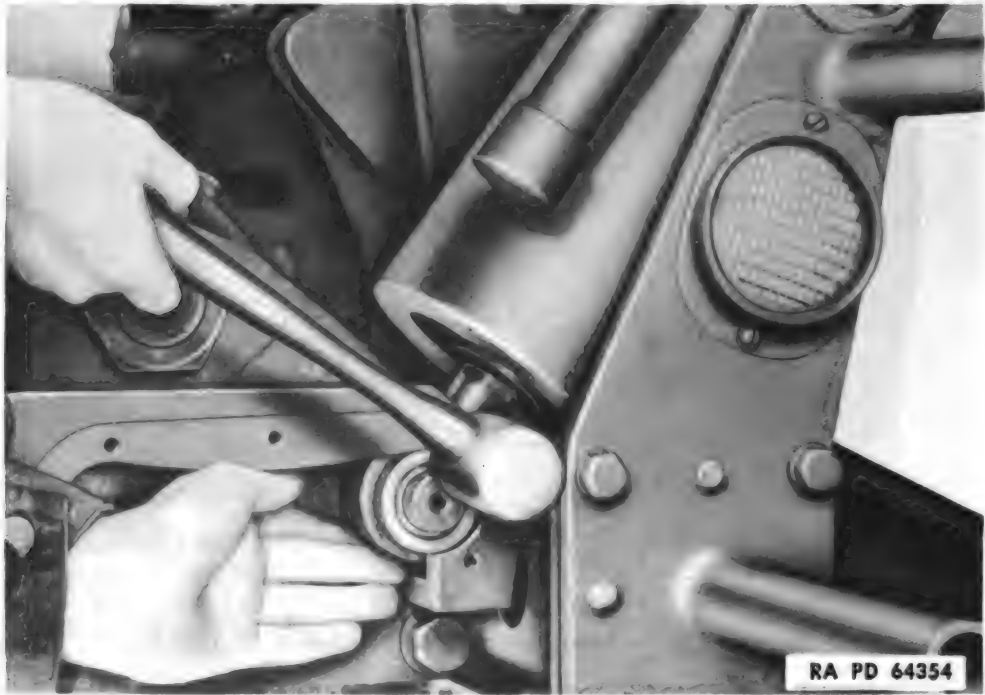


Figure 154—Installing Counterpoise Rod Pin and Bearings

b. Installation.

(1) Drive at least three of the dowel pins flush with inner face of counterpoise support, using copper hammer to prevent damaging pins.

(2) Place counterpoise cylinder in position and enter inner trunnion stud in bearing of stationary support. Continue to support cylinder and install outer support. Align dowel pins carefully before driving them in place. Install the four cap screws and lock washers.

(3) Install the trunnion stud nuts A147005 and tighten until the threads in hole for setscrew are in exact alignment. Install setscrew. If undue force is required, remove screw and move nut slightly until setscrew enters freely.

(4) Place outer rod bearing A146681 in center of counterpoise rod pin, and lower rear end of counterpoise cylinder, positioning rod eye in axle bracket. With outer bearing in position on pin as described above, install pin and bearing, inserting pin in eye of rod. Place inner bearing A146681 behind rod and hold in position while tapping pin in place with copper hammer.

(5) Install axle bracket cover and secure with five screws and lock washers.

(6) Tighten counterpoise rod nut and lock nut until the same number of threads is exposed as was visible before removal. Hold rod nut and tighten lock nut securely.

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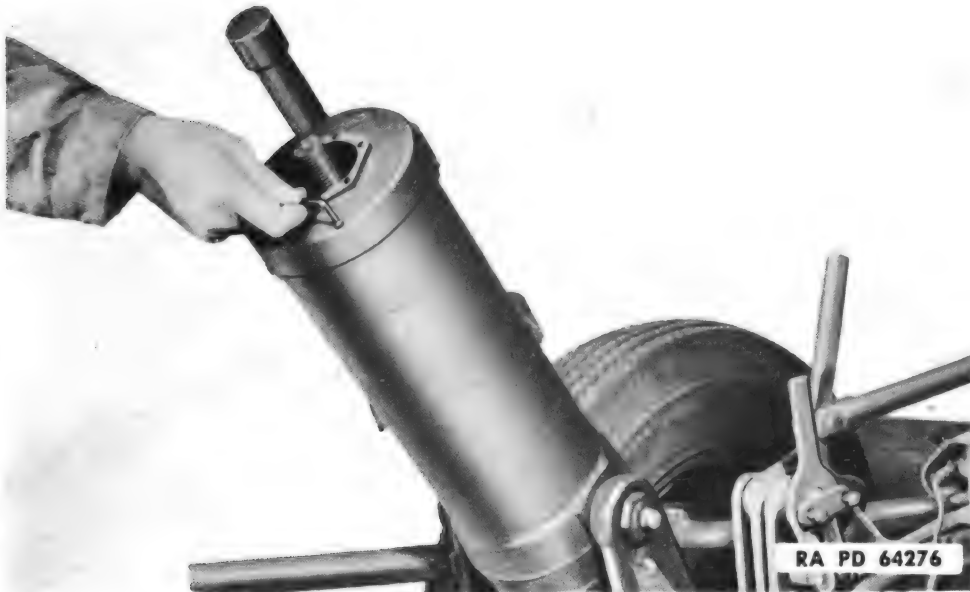


Figure 155—Loosening Setscrew in Cylinder Cover

(7) Replace dust guard and install the six screws.

c. Disassembly. Counterpoise cylinders should remain on carriage during disassembly. Rear wheels must be removed when disassembling rear counterpoise assemblies.

(1) Remove the six screws which secure counterpoise dust guard and remove dust guard.

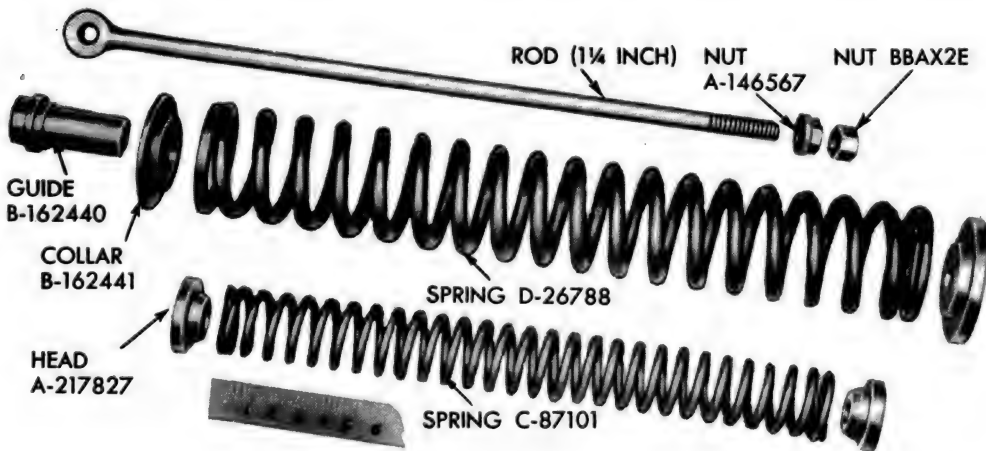
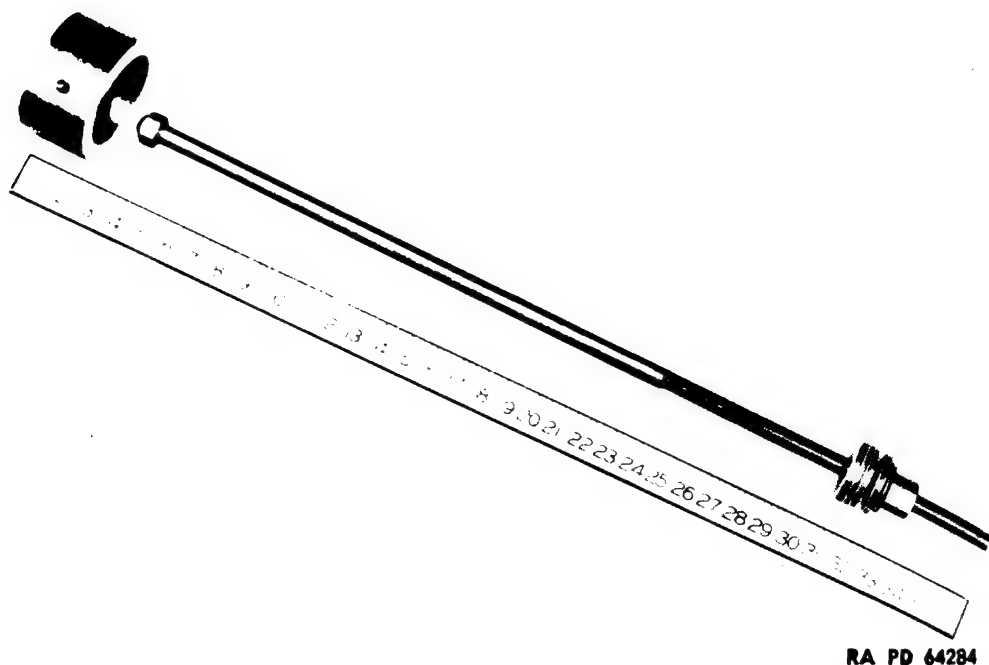


Figure 156—Counterpoise Spring Assembly—Exploded View

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Figure 157—Counterpoise Spring Compressor Tool

NOTE: Count the number of exposed threads on rod, extending from lock nut, so same adjustment can be obtained upon reassembly.

(2) Turn counterpoise rod nut, compressing springs until there is a space of approximately $2\frac{3}{4}$ inches between counterpoise piston and cylinder cover.

(3) Remove cylinder cover by first loosening the $\frac{1}{4}$ -20 socket-head setscrew which locks cover to end of cylinder, then use an 18-inch knife-handle adjustable wrench and unscrew cover.

CAUTION: To avoid personal injury should the pressure of the counterpoise springs be accidentally released, do not stand in front of the counterpoise cylinder assembly during or after removal of cover.

(4) Place spacing collar of spring compressor tool in end of cylinder and replace cover. Tighten cover and secure with the $\frac{1}{4}$ -20 socket-head setscrew.

(5) Remove counterpoise rod nut and lock nut. The pressure of the compressed spring will now be against the spacing collar and cover, so counterpoise rod may be disconnected from axle bracket.

(6) Remove the five screws and lock washers securing axle bracket cover and lift off cover.

(7) Disconnect counterpoise rod from axle bracket by removing the counterpoise rod pin A146680. Use a $\frac{3}{8}$ -16 NC-2 cap screw in threaded

MAINTENANCE AND REPAIR INSTRUCTIONS



Figure 158—Placing Spring Compressor Spacing Collar in Cylinder

hole in end of pin, to withdraw pin from rod bearings and eye of counterpoise rod.

CAUTION: To prevent the cylinder from swinging down and injuring personnel, support upper end of cylinder while removing pin.

(8) Lower front end of cylinder disengaging rod from the two rod bearings A146681 and axle bracket. Withdraw the rod C87054 from cylinder.

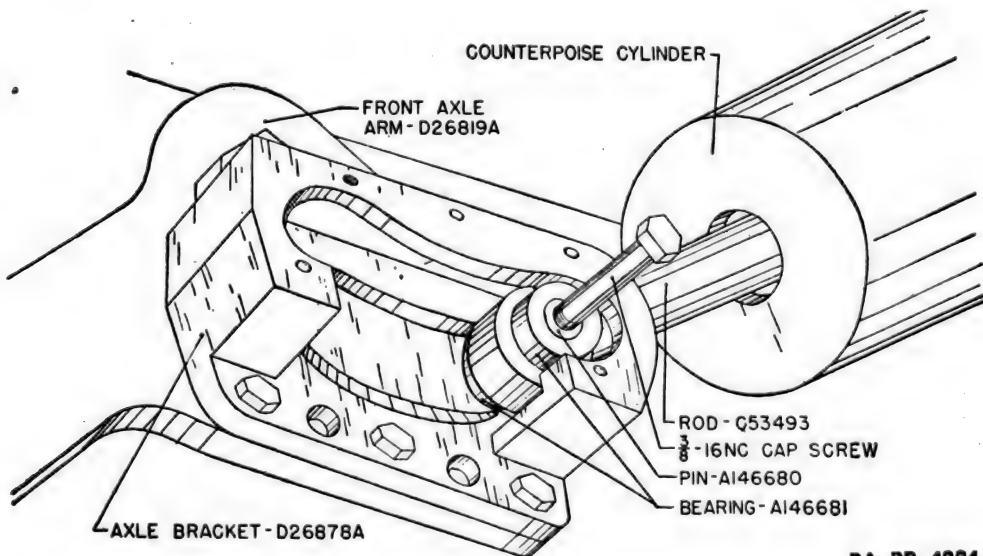


Figure 159—Removing Counterpoise Rod Pin

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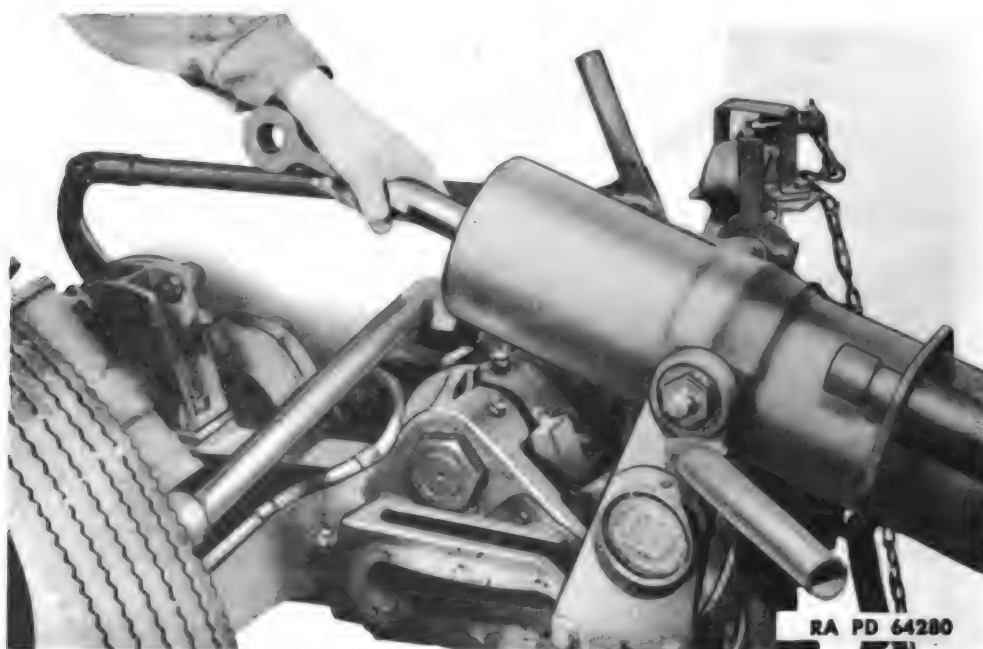


Figure 160—Removing Counterpoise Rod

(9) Insert the spring compressor rod in cylinder so threaded end of it extends through lower end of cylinder. Place ball bearing on rod so the flat side of bearing is towards bottom of cylinder and install nut on rod so it seats in recess in bearing.

(10) Use equilibrator wrench B161473 on the nut which is pinned to upper end of rod, to prevent compressor rod from turning, and tighten nut on lower end of rod against thrust bearing until spring pressure is relieved from spacing collar. Remove cover and spacing collar.

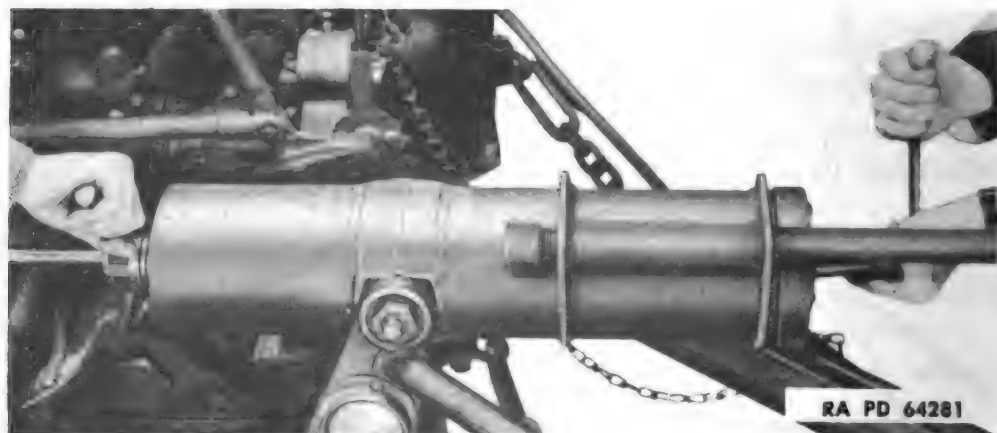


Figure 161—Using Counterpoise Spring Compressor Tool

MAINTENANCE AND REPAIR INSTRUCTIONS



RA PD 5773

Figure 162—Adjustment of Counterpoise Spring

(11) Unscrew the nut on lower end of compressor rod, releasing both counterpoise springs until fully extended. Remove nut and bearing and withdraw compressor rod.

(12) Lower front end of cylinder and remove counterpoise spring assemblies; then remove the rod guide B162440 from bottom of cylinder.

d. Inspection.

(1) Clean all parts thoroughly and examine springs for cracks, also check spring for having taken a permanent "set" by comparing measurements with those of new springs. A new outer spring D26788 measures approximately 28 $\frac{3}{4}$ inches and a new inner spring C87101 measures approximately 24 $\frac{3}{4}$ inches. If adjustment of old springs cannot be secured, to assist adequately in raising and lowering carriage, replacement may be necessary.

(2) Check piston, rod guide collar, rod guide, and spring heads for excessive wear and remove all burs.

(3) Examine counterpoise rod for evidence of binding which might indicate that rod is bent. Straighten or replace bent rod.

(4) Lubricate all internal parts with a light coating of GREASE, O.D. (seasonal grade), before assembling.

e. Assembly.

(1) Place counterpoise rod guide B162440 and rod guide collar B162441 in bottom of cylinder.

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(2) Install piston head A217828, outer spring, and inner spring, and see that both springs seat properly.

(3) Place spring head A217827 in upper end of inner spring and piston B127741 in outer spring.

(4) Install spring compressor rod through upper end of cylinder and place thrust bearing and nut on lower end of rod.

(5) Compress springs until piston is $2\frac{3}{4}$ inches below top of cylinder; then install spacing collar and replace counterpoise cover. Tighten securely.

(6) Remove spring compressor tool and check the alinement of openings through which counterpoise rod is to be installed; correct any mis-alinement with a round bar.

(7) Pivot cylinder to horizontal position and install rod, guiding it through the spring head and piston, with a screwdriver.

(8) Place a rod bearing A146681 in center of rod pin, and lower rear end of counterpoise cylinder, positioning rod eye in axle bracket. With outer bearing in position on pin as described above, install pin and bearing, inserting pin in eye of rod. Place the other bearing A146681 behind rod and hold in position while tapping pin in place with copper hammer.

(9) Install axle bracket cover and secure with five screws and lock washers.

(10) Install counterpoise rod nut and lock nut and compress springs sufficiently to relieve pressure on spacing collar; then remove cylinder cover and lift out collar.

(11) Replace cover and tighten securely. Tighten $\frac{1}{4}$ -20 socket-head setscrew.

(12) Adjust counterpoise rod nut and lock nut until same number of threads is exposed as were visible before disassembly.

NOTE: This method of adjusting can be used only when the same springs have been reinstalled. In the event a new spring has been installed, final adjustment should be made while lowering and raising carriage. Adjustment should be such that carriage (with gun mounted) will descend to the ground without undue force and enable it to be lifted to traveling position with one man at each wheel.

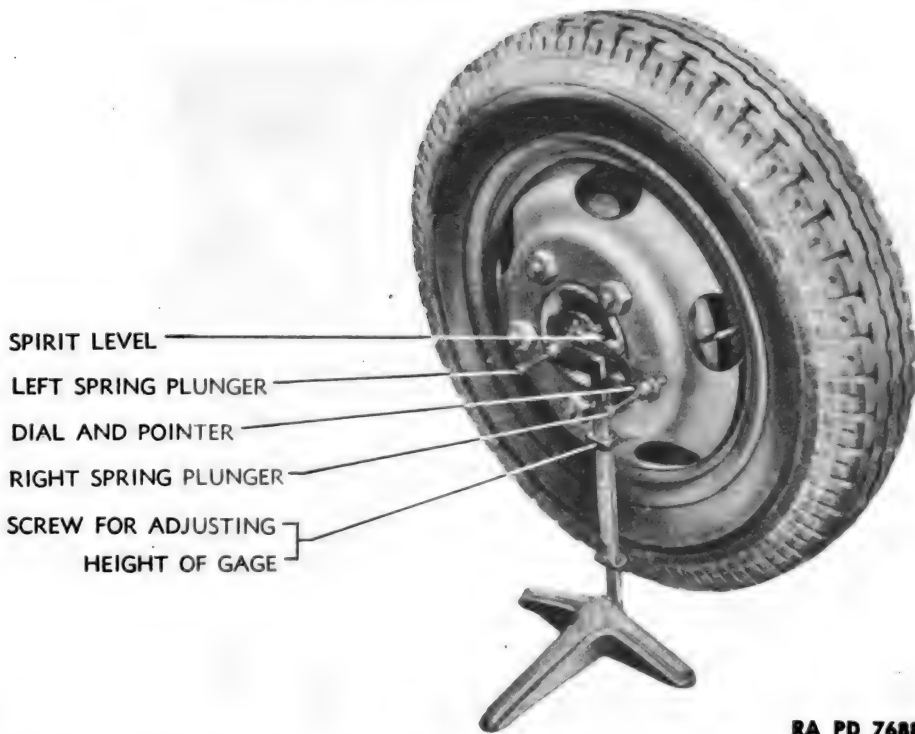
(13) After adjustment is obtained, lock counterpoise rod nuts securely, and install the dust guard.

50. WHEEL AND HUB ASSEMBLY.

a. Removal. Wheel stud nuts BW37889 on left front and left rear wheels have left-hand thread, while stud nuts BW37888 on right front and right rear wheels have right-hand threads.

(1) Jack up wheel and support frame of carriage with blocks.

MAINTENANCE AND REPAIR INSTRUCTIONS



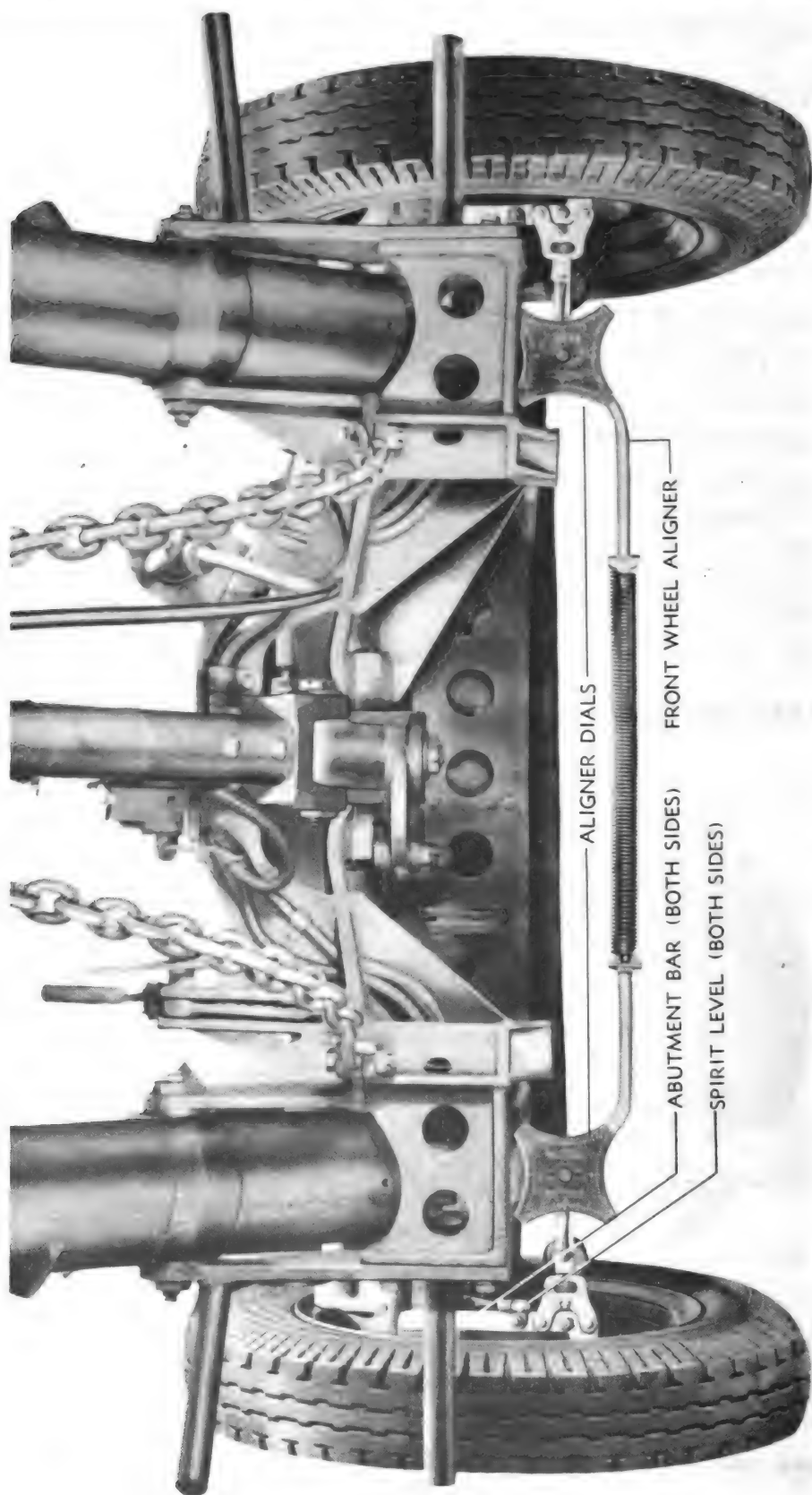
RA PD 7688

Figure 163—Caster Gage with Left Spring Plunger in Wheel Spindle Lathe Center



RA PD 7689

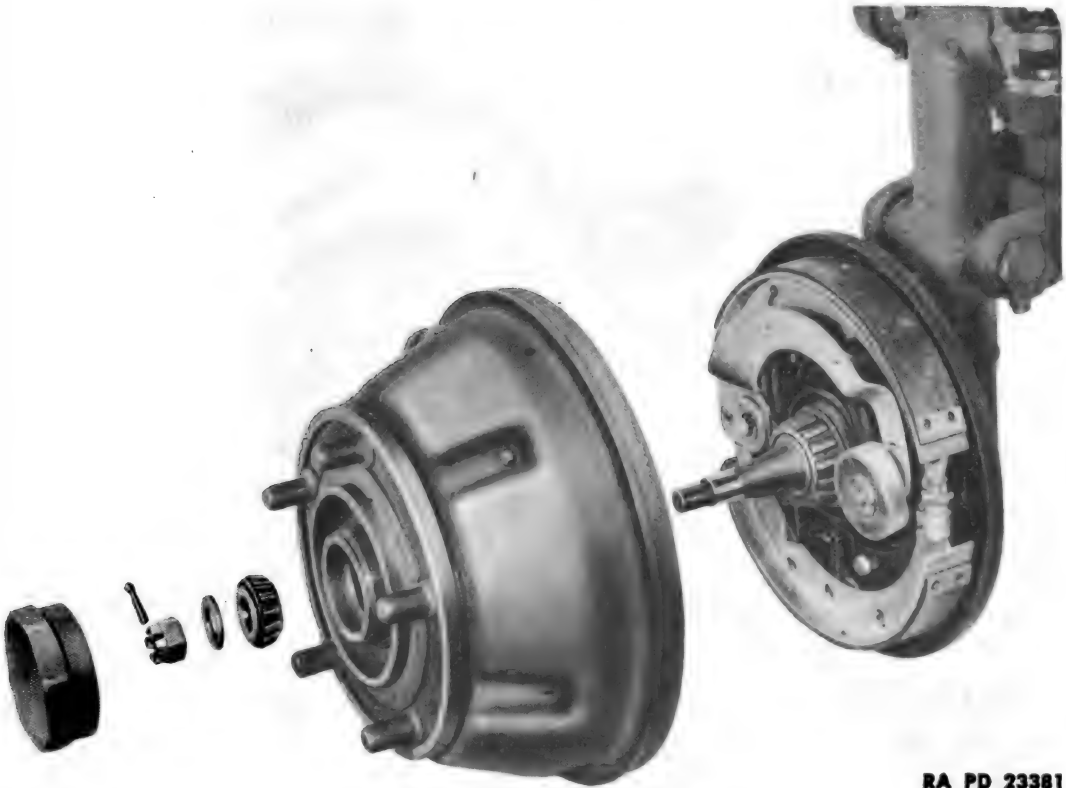
Figure 164—Caster Gage with Right Spring Plunger in Wheel Spindle Lathe Center



RA PD 7687

Figure 165—Checking Front Wheel Camber

MAINTENANCE AND REPAIR INSTRUCTIONS



RA PD 23381

Figure 166—Dismounted Hub and Drum Assembly

(2) Remove wheel and tire, taking out five stud nuts, BW37889 for left wheels and BW37888 for right wheels. Dismount wheel and tire assembly as one unit.

(3) Remove hub cap, using hub cap wrench. All four hub caps have right-hand threads.

(4) Remove cotter pin from hub retaining nut BBHX1C and unscrew nut from spindle. Remove lock washer A146762.

(5) Remove hub part away from spindle assembly and remove outer bearing cone 1779. Remove hub and drum assembly.

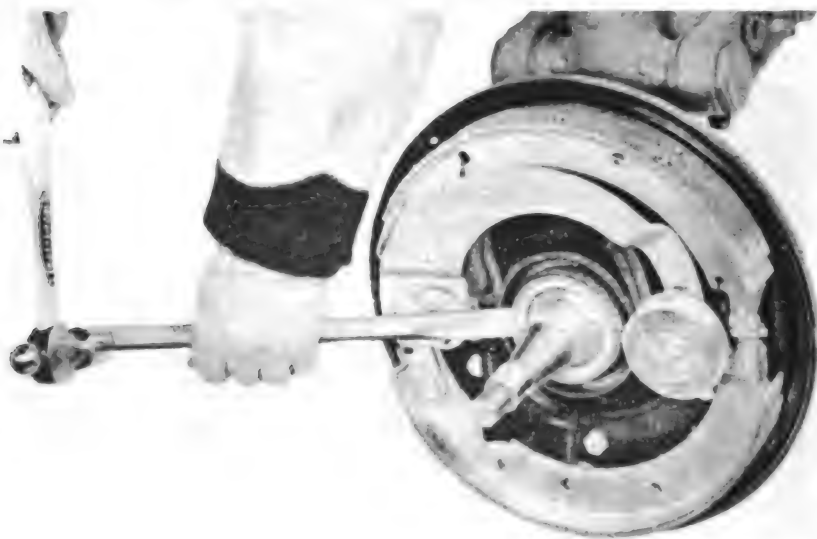
b. Disassembly.

(1) Remove inner bearing cone 3382 from spindle, using two thin pry bars or heavy-duty screwdrivers to pry off bearing. Bearing cone is a light press fit on spindle.

CAUTION: Use extreme care in removing bearing cone assembly to avoid damaging the bearing or grease retainer behind bearing.

(2) Remove felt retainer 1205-4-164 by prying off spindle, using small pry bar and hammer. Then remove felt seal.

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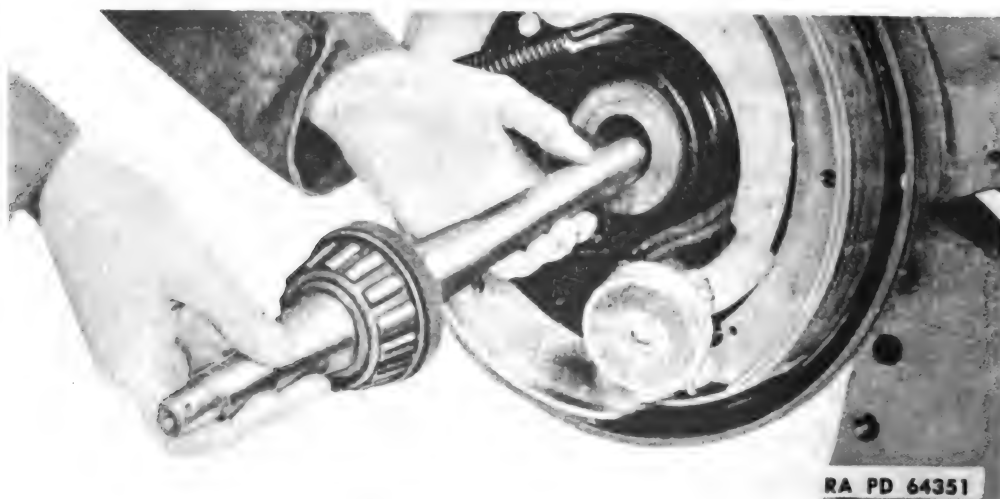


RA PD 23383

Figure 167—Removing Felt Seal—Front Wheel

NOTE: The felt grease seal can be easily removed from rear wheels by first removing wheel and hub assembly and then removing the cotter pin and nut securing rear wheel spindle B127858 and withdrawing spindle. Felt seal can be quickly inspected and replaced, and spindle returned to position and secured by nut and cotter pin.

(3) To remove bearing cups, drive or press outer bearing cup 1729 out of small end of wheel hub assembly. Drive or press inner cup 3320 out of the large opening of hub. Use brass drift to avoid chipping parts.



RA PD 64351

Figure 168—Removing Felt Seal—Rear Wheel

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RA PD 64389

Figure 169—Removing Armature Plate

(4) To dismount armature plate, remove five cap screws and washers and take armature plate out of hub assembly.

(5) To dismount drum from hub, remove five stud nuts 2686-E-7, which are staked in place, by using heavy-duty socket wrench; then drive out studs and remove brake drum.

c. Inspection.

(1) Examine hub assembly and inspect for worn or broken bearing cups.

(2) Inspect bearings and clean by flushing in SOLVENT, dry-cleaning, protecting them from dirt until installed.

d. Assembly.

(1) Install brake drum on hub and press five new studs in place. Install retaining nuts and tighten securely; then stake in place.

(2) Install brake armature plate in position in brake drum and secure with cap screws and washers.

(3) Install bearing cups 1729 and 3320, drifting them into wheel hub assembly with brass drift. Make certain cups are installed evenly with small opening of each cup toward center of the wheel hub.

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL

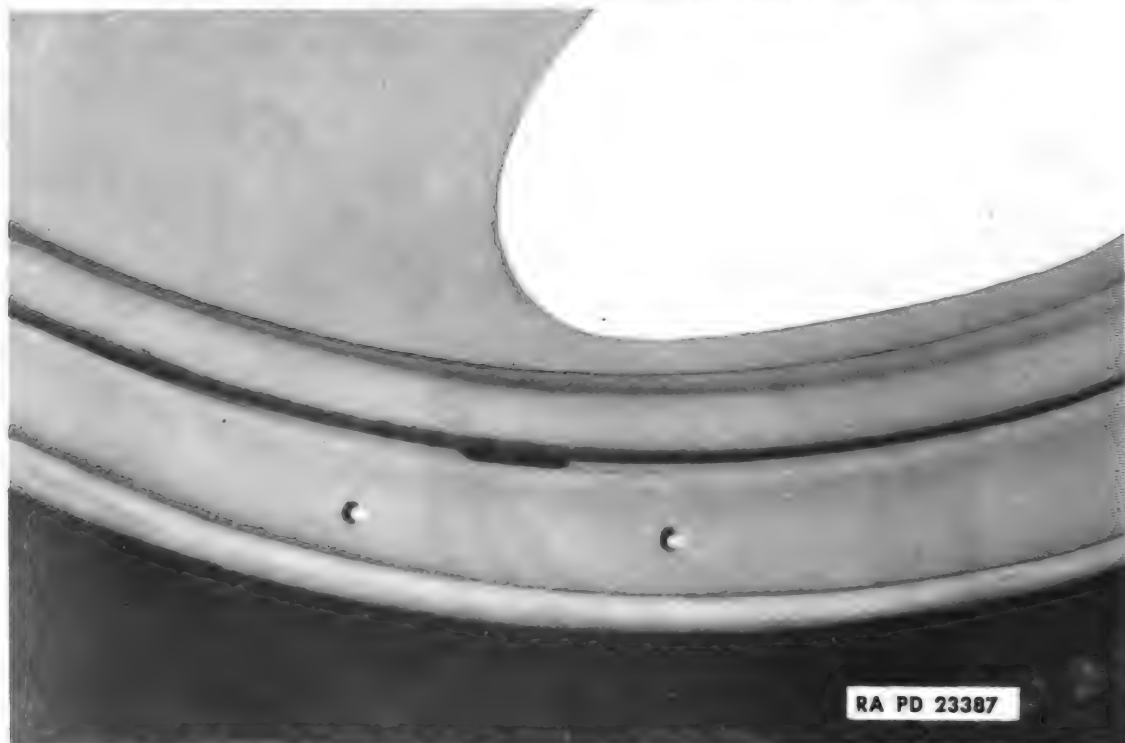


Figure 170—Tire Locking Ring Slot

(4) Install a new felt grease seal TDA5X126 on spindle and then place retainer 1205H164 onto wheel spindle.

(5) Install inner bearing cone 3382 on wheel spindle and press or tap into position, using brass drift.

NOTE: Lubricate inner bearing thoroughly. Also coat inside of hub and spindle with a thin coat of grease to prevent rusting.

(6) Place hub assembly in position on wheel spindle, lubricate and replace outer bearing cone 1779, lock washer A146762, and nut BBHX1C, but do not tighten.

(7) Replace wheel and tire assembly on hub, installing five stud nuts, BW37889 for left wheels and BW37888 for right wheels, and tighten securely.

(8) Adjust wheel bearings, turning hub retaining nut BBHX1C until bearings are tight and wheel cannot be shaken by hand but can be rotated free without binding. There should be no looseness in bearings. Install cotter pin in retaining nut, replace hub cap, and tighten with hub cap wrench.

(9) Lower wheel to ground and check stud nuts, evenly drawing them tight.

MAINTENANCE AND REPAIR INSTRUCTIONS

51. LEVER TYPE ELECTRIC BRAKES.

a. **General.** All four-wheel lever type brake assemblies are of identical construction except for right and left parts and the addition of the hand brake controls on the rear wheel brakes. As a result, the instructions given in this section will apply to all brake units unless otherwise noted. Each brake unit may be removed and installed individually. Some parts such as the brake shoes and magnets should be replaced in pairs as to right and left to give most efficient brake action.

b. **Removal and Disassembly.**

(1) Raise the chassis until tire is off the ground and place support under chassis.

(2) Remove wheel by removing five wheel stud nuts. Wheel studs on right side of carriage have right-hand threads, and wheel studs on left side of carriage have left-hand threads.

NOTE: If brakes are only opened for inspection, the hub and wheel may be removed as a unit, but if adjustment of brake shoes is to be made, the wheel should be removed to give access to the slot in brake drum through which a feeler gage must be inserted.

(3) Remove hub cap, cotter pin, and hub retaining nut, and dismount hub assembly.

NOTE: If hub assembly is pulled out about $\frac{1}{2}$ inch and then pushed back in place, it will allow easy removal of safety washer and outer bearing cone.

(4) Disconnect brake actuating lever from anchor pin by removing ring A228878 and washer A228887. Then pull actuating lever off anchor pin.

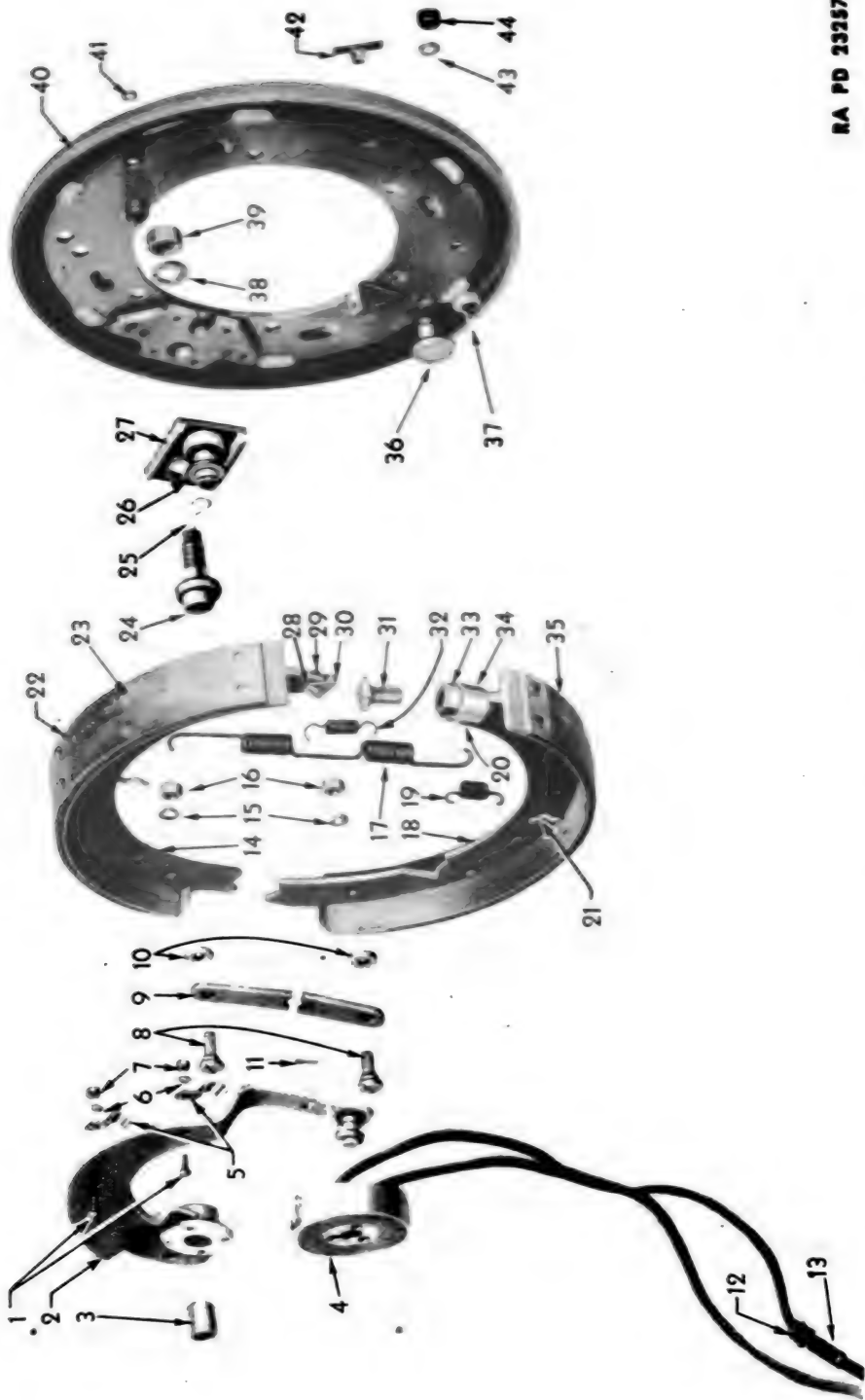
(5) Unhook brake shoe retracting spring B229812 or B198569 from primary (top) brake shoe and remove spring.

NOTE: The above operation will be facilitated by use of spring pliers B110681.

(6) Remove equalizer spring B198568 from secondary (bottom) brake shoe.

(7) Remove pins A228870 from shoe side springs and lift both brake shoes off anchor pin and dismount from brake backing plate.

(8) Disassemble brake shoe assemblies by unhooking spring A228885 which is attached to each shoe at adjusting screw end. Remove retaining nuts BBBX1C, washers BECX1K, screws A228884, links A228856, and washers A228889. Then unscrew the adjusting screw B198567 from the secondary shoe. Also remove clevis A228844 from toe end of primary shoe after removing cotter pin BFAX1CC and pin A228871.



RA PD 23257

Figure 171—Electric Brake, Front, R. H.—Exploded View

MAINTENANCE AND REPAIR INSTRUCTIONS

1—Screw BCNX3EG	16—Nut BBBX1C	31—Screw B198567
2—Lever C95698	17—Spring B229812	32—Spring A228885
3—Bearing A228858	18—Shoe A228870	33—Nut A228881
4—Magnet A229811B	19—Spring B198568	34—Clamp A228882
5—Clip A228847	20—Rivet BMCX1	35—Lining A228847
6—Washer BECX1C	21—Pin A228870	36—Equalizer A228851
7—Nut A228869	22—Lining C97378A	37—Spring A228886
8—Screw A228884	23—Rivet A228880	38—Washer BECX1P
9—Link A228856	24—Pin B198566	39—Nut BBBX2B
10—Washer A228889	25—Ring A228878	40—Plate D59604A
11—Pin BFAX1BC	26—Washer A228887	41—Anchor A228883
12—Grommet A228855	27—Pin and Plate A228867	42—Cover B198550
13—Connector A228848	28—Pin A228871	43—Washer BECX1K
14—Shoe C97376	29—Pin BFAX1CC	44—Nut BBBX1C
15—Washer BECX1K	30—Clevis A228844	

Legend for Figure 171 — Electric Brake, Front, R. H.—Exploded View

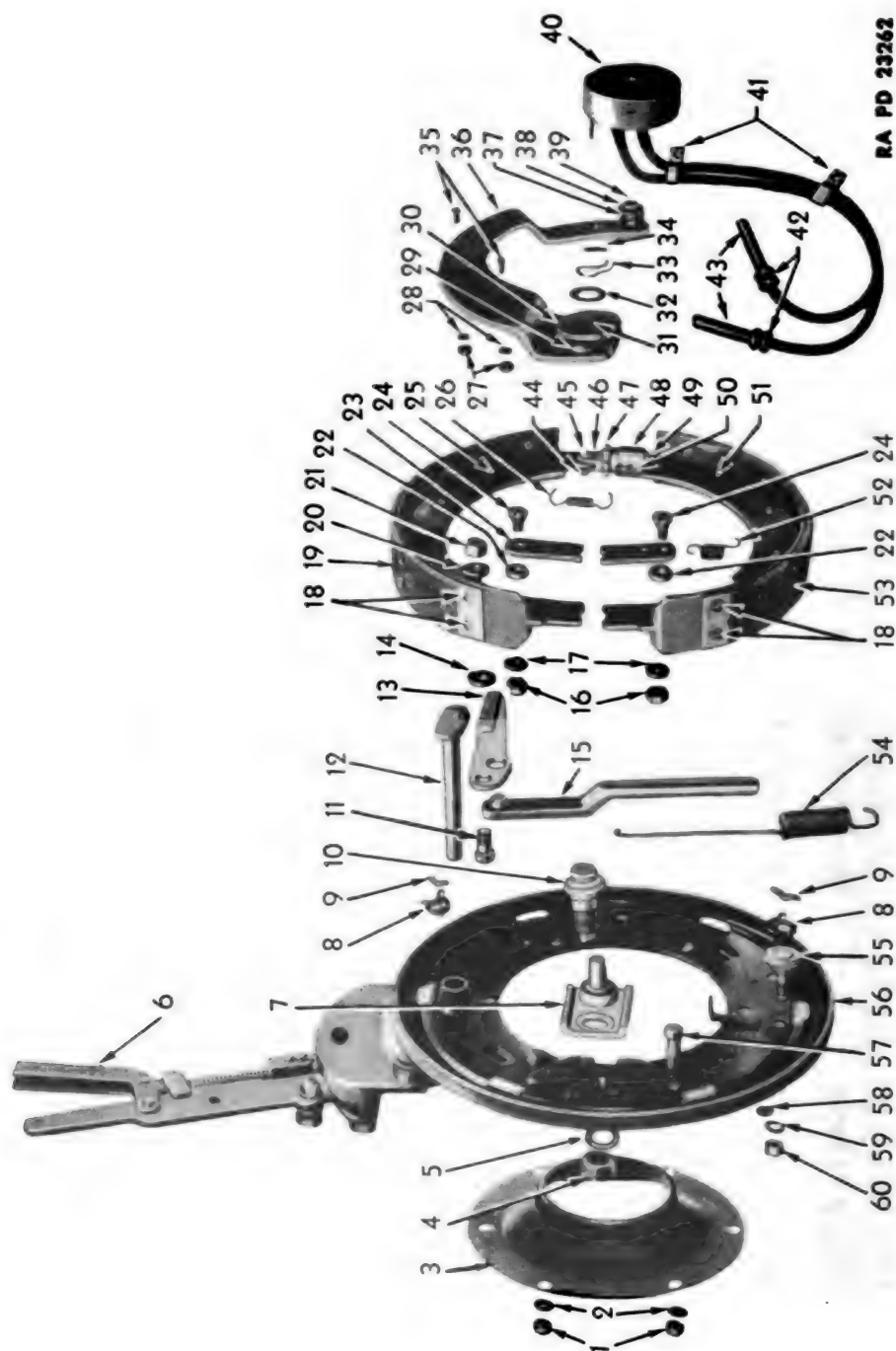
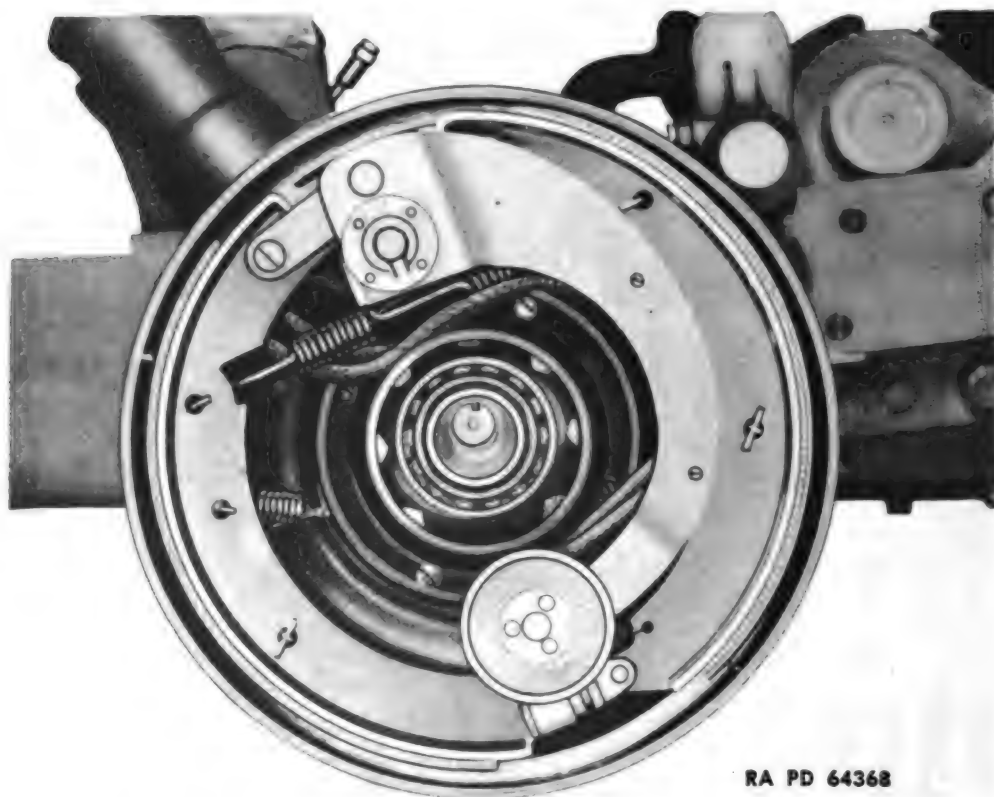


Figure 172—Hand and Electric Brake, R. H.—Exploded View

MAINTENANCE AND REPAIR INSTRUCTIONS

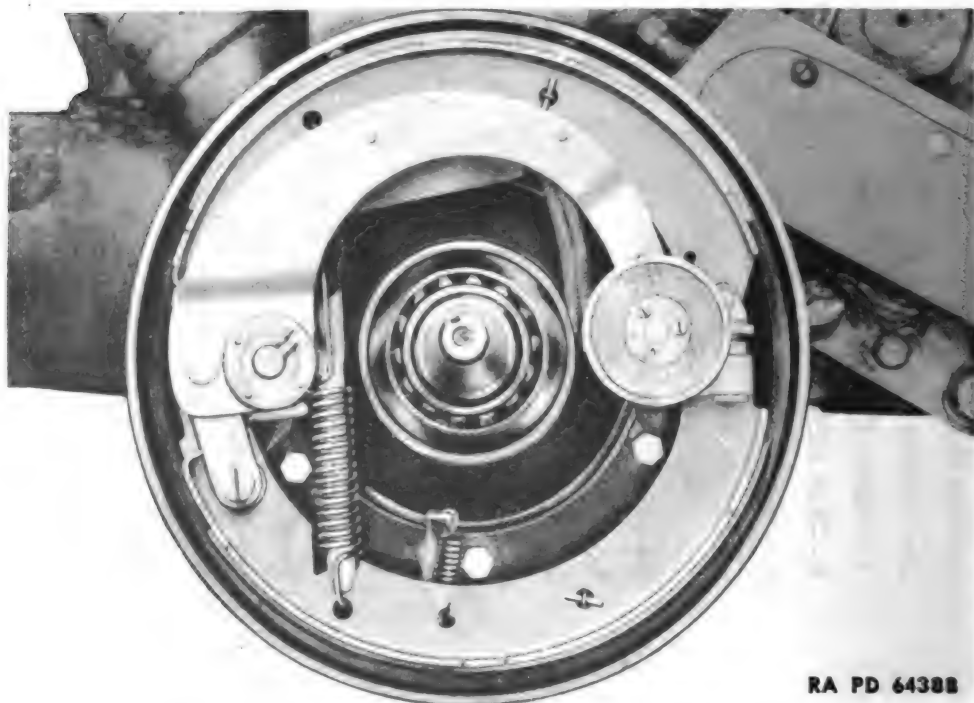
1—Nut BBBX1C	21—Nut BBBX1D	41—Clip A228847
2—Washer BECX1K	22—Washer A228889	42—Grommet A228855
3—Baffle C95713	23—Link A228856	43—Connector A228848
4—Nut BBBX2B	24—Screw A228884	44—Pin BFAX1CC
5—Washer BECX1P	25—Shoe C97376	45—Pin A228871
6—Brake, Hand, R.H., Assembly	26—Spring A228885	46—Clevis A228844
7—Pin and Plate A228867	27—Nut A228869	47—Screw B198567
8—Spring A228886	28—Washer BECX1C	48—Clamp A228882
9—Pin A228870	29—Stud A228859	49—Nut A228881
10—Pin B198566	30—Bushing A228857	50—Rivet BMCX1
11—Stud B198570	31—Bearing A228858	51—Shoe C97377
12—Cam B198306	32—Washer A228887	52—Spring B198568
13—Lever A228864A	33—Ring A228878	53—Lining C97378B
14—Washer A228888	34—Pin BFAX1BC	54—Spring B198569
15—Link B198564	35—Screw BCNX3EG	55—Equalizer A228851
16—Nut BBBX1C	36—Lever C95699A	56—Plate D50456B
17—Washer BECX1K	37—Spring A228861	57—Screw A228377
18—Rivet A228880	38—Washer A228863	58—Anchor A228883
19—Lining C97378A	39—Pin A228862	59—Washer BECX1L
20—Washer BECX1L	40—Magnet B229811D	60—Nut BBBX1D

Legend for Figure 172—Hand and Electric Brake, R. H.—Exploded View



RA PD 64368

Figure 173—Lever Type Electric Brake—Front



RA PD 64388

Figure 174—Lever Type Electric Brake—Rear

MAINTENANCE AND REPAIR INSTRUCTIONS

NOTE: On rear wheel brakes, also remove retaining nut BBBX1D, washers BECX1L and A228888, stud B198570, and lever A228864. Link B198564 is removed simply by pulling it away from lever A228864.

(a) No further disassembly of the brake support plate D59604 or D50456 and brake actuating lever C95698 or C95699 is necessary if only the shoe assemblies are to be replaced or otherwise serviced.

(9) Detach brake lever from magnet by removing cotter pin BFAX1BC and both wire clips A228847; detach magnet A229811 or B229811 from brake actuating lever C95698 or C95699. The needle bearing A22858 can also be removed from brake actuating lever, if necessary, by pushing it out of position.

(10) Remove clamp A228849 and cover A228850 which hold magnet wires to back side of brake shoe support plate. Remove tape from connectors A228848 and disconnect magnet wires by pulling on wire and connector.

(11) Pull magnet wires out of brake support plate, working rubber grommets out of plate with a small blunt screwdriver or other suitable tool.

(12) Remove brake lever fulcrum plate by removing nut BBBX2B with a $\frac{15}{16}$ -inch wrench and remove pin B198566 and plate A228867.

(13) Using a $\frac{9}{16}$ -inch wrench, remove secondary shoe equalizer by removing nut BBBX1D and washer.

(14) Remove both brake shoe side springs A228886 and anchors A228883.

(15) Using a $\frac{9}{16}$ -inch wrench, remove brake support or backing plate by removing six screws A228377, washers, and nuts.

c. Inspection.

(1) Clean all parts thoroughly, and inspect for wear and possible damage. Replace all parts that are worn, broken, bent, or otherwise unfit for further service.

CAUTION: Grease on the brake shoe linings destroys the effectiveness of the brakes and results in grabbing, unequal braking, or poor brake action. A complete relining is recommended after eliminating the cause of the leakage, which can usually be traced to worn oil seals in the wheel hubs or overlubrication of wheel bearings. Extreme care should be taken in removal of brake shoes, if original shoes are to be reinstalled, to prevent oil or grease from getting on linings as the slightest amount of oil will upset even braking of all four wheels. Gasoline should not be used to clean grease from brake drums as this will leave an oily residue. Use a SOLVENT, dry-cleaning, for such cleaning. Flint

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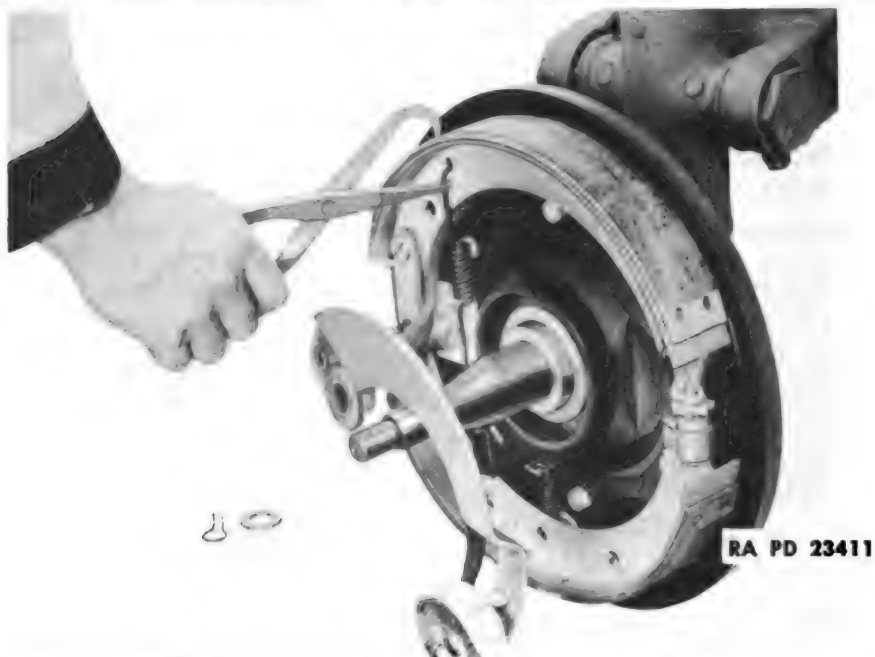


Figure 175—Removing Brake Shoe Retracting Spring

paper may be used lightly to remove finger marks from brake lining.

(2) Brake linings should be replaced when they have worn down even with the rivet heads which hold them to the brake shoes. If the

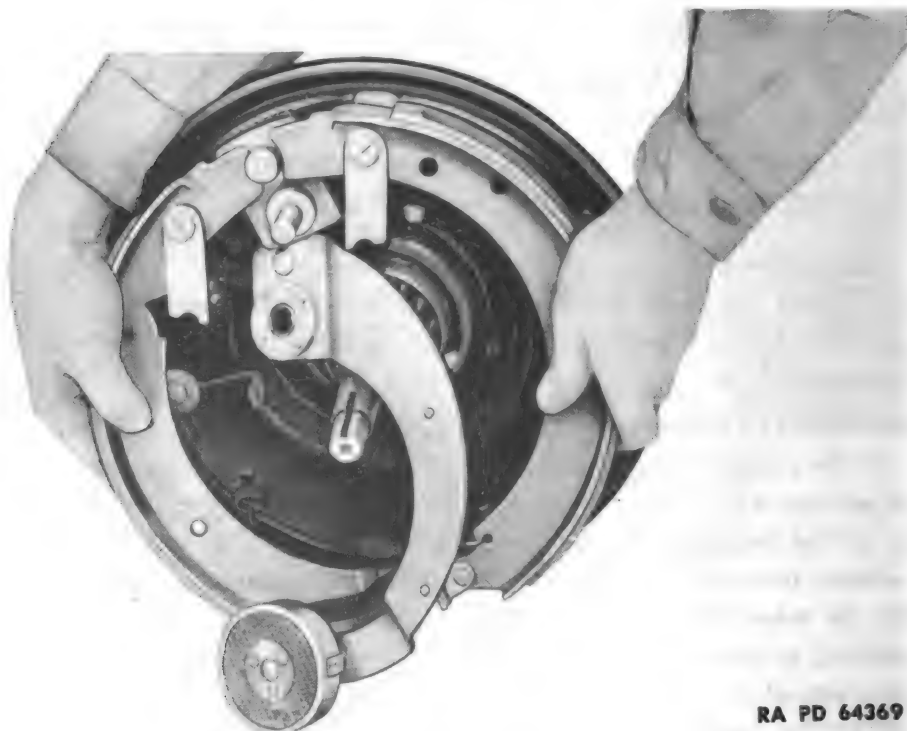


Figure 176—Dismounting Brake Shoes

MAINTENANCE AND REPAIR INSTRUCTIONS



Figure 177—Brake Shoe Assemblies and Connecting Parts—Rear

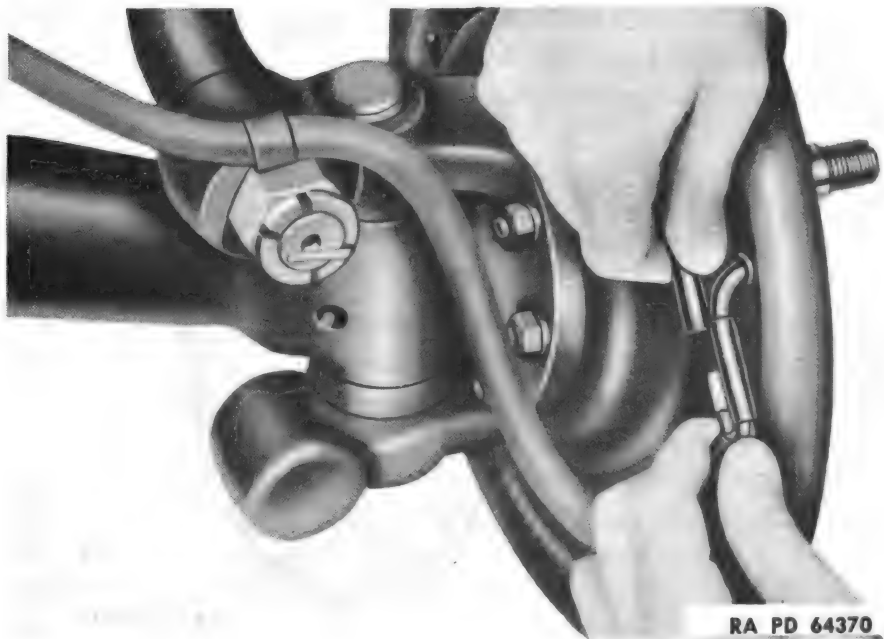


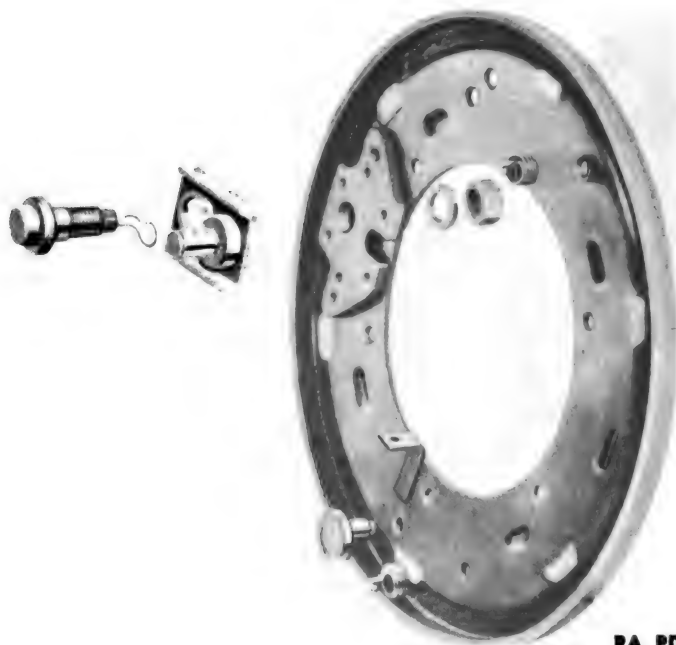
Figure 178—Disconnecting Magnet Wires

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RA PD 23416

Figure 179—Magnet and Wire Assembly

lining is not replaced or new shoes installed, metal to metal contact may score the brake drums, necessitating machining of the drums, or replacement in extreme cases.



RA PD 23417

Figure 180—Brake Backing Plate, Anchor Pin, and Fulcrum Plate

MAINTENANCE AND REPAIR INSTRUCTIONS

(3) Examine brake springs for weakness, or hooked ends that have straightened out, which will prevent their proper installation and functioning.

(4) Examine magnet and armature plate for wear. If armature plate is worn and grooved, it may be removed from brake drum, reversed, and installed so that other side is against the magnet.

d. Assembly and Installation.

(1) Mount the brake backing or support plate D59604 or D50456 and baffle C95713 in position on spindle flange. Holes in baffle D95713 will line up with those in the support plate D59614 or D50456 in only one position with one of the depressions in the baffle opposite the shoe pin and plate A228867. Then install six screws A228377, washers, and retaining nuts BBBX1C.

(2) Install equalizer A228851 in position on brake support plate and install washer and retaining nut BBBX1D.

(3) Mount fulcrum plate A228867 in position on backing plate and install pin B198566, washer BECX1P, and nut BBBX2B.

(4) Insert magnet wires through holes in backing plate, attach them to the connectors, and push in place on brake support. Next, install clamp A228849 and cover A228850. Also, install rubber grommets A228855 in brake support holes by working them in position with a blunt screwdriver or other suitable tool.

(5) Mount brake actuating lever C95698 or C95699 in position on magnet and install cotter pin, clips A228847, screws BCNX3EG, washers BECX1C, and nuts A228869. Also, install bearing A228858 in brake lever.

(6) Install both shoe side springs A228886 and anchors in holes in backing plate. Attach links A228856 and washers A228889 to outer side of shoes with screws, washers, and retaining nuts.

(7) Assemble brake shoes, with primary shoe (stamped "P") at the top and secondary shoe (stamped "S") at the bottom. Assemble the adjusting nut clevis A228844 to the primary shoe and adjusting screw A198567, nut A228881, and clamp A228882 in position on secondary shoe and attach spring A228885 to hold shoes together.

NOTE: On rear wheel brakes, also install shoe lever A228864, stud B198570, washers A228888 and BECX1L, and retaining nut BBBX1D for the hand brakes.

(8) Position shoes on backing plate so that each side spring will enter its receiving hole, pull end of spring through hole with a hooked tool or wire, and install pin A228870. Push shoes against anchor pin.

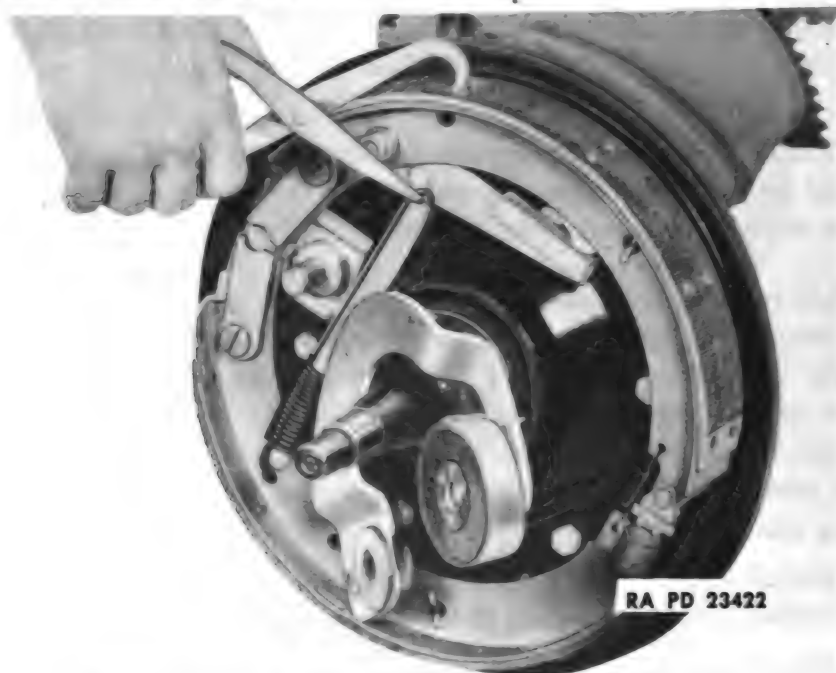


Figure 181—Installing Brake Retracting Spring

NOTE: On rear wheel brakes, insert push link B198564 in retracting spring B198569 and attach retracting spring to secondary shoe before installing primary shoe. Then install primary shoe and connect push link B198564 to the shoe lever A228864 on the primary shoe. Also, install magnet wires between the retracting spring B198569 and push link B198564.

(9) Install brake retracting spring, using spring pliers to hook upper end in the primary shoe.

(10) Mount brake actuating lever C95698 or C95699 in position on the brake shoe anchor pin and plate A338867 and install washer A22887 and spring ring A228878.

NOTE: When installing the brake actuating lever C95698 or C95699, make sure both shoe links A228856 are in place on the lever stud.

(11) Install hub and drum on wheel spindle and adjust bearings as described in paragraph 50 d. Brakes should now be adjusted in accordance with the following instructions.

e. Adjustment. If brakes have been giving satisfactory service and new shoes and linings have not been installed, it is not necessary to adjust the anchor pin as described in step (6) below.

(1) Remove wheel, hub, and drum assemblies, and clean out accumulated foreign substance. See that shoes move freely on backing plate and are seated against the anchor pin.

MAINTENANCE AND REPAIR INSTRUCTIONS

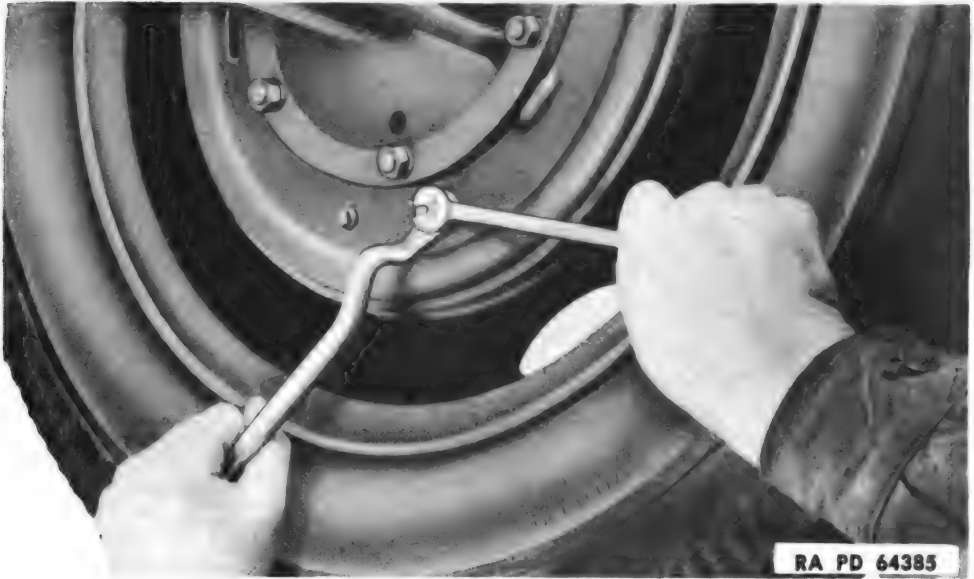


Figure 182—Adjusting Equalizer

(2) Reinstall hub and drum assemblies and loosen nut on secondary shoe equalizer A228851 just enough to allow equalizer to turn.

(3) Turn the equalizer in direction the wheel revolves when in forward motion until brake has considerable drag.

(4) Turn brake drum so that slot for feeler gage is near equalizer and insert a 0.010-inch feeler gage between drum and brake lining. Then turn the equalizer in opposite direction very slowly until only a slight drag is felt on feeler gage. Tighten the equalizer, lock nut, and recheck clearance to see that equalizer has not moved while tightening lock nut. Use a $\frac{3}{16}$ -inch wrench on brake equalizer and a $\frac{9}{16}$ -inch wrench on lock nut.

(5) With the secondary shoe properly adjusted, remove the small metal cover B198550 in the backing plate and expand the adjusting screw with tool B110685 until brake drags slightly. Then release the adjusting screw until only a slight drag is felt on a 0.010-inch feeler gage placed at the center of the primary shoe.

NOTE: Be sure to replace brake backing plate adjusting hole covers B198550 to prevent entry of foreign substances.

(6) If new shoes or relined shoes have been installed, the anchor pin must be adjusted. First adjust the equalizer on the secondary shoe as described in steps (3) and (4) above. Then insert a 0.010-inch feeler gage between lining and drum about $1\frac{1}{2}$ inches from adjusting screw end of secondary (bottom) shoe and expand shoes with adjusting screw

ORDNANCE MAINTENANCE—37-MM ANTIAIRCRAFT GUN MATERIEL

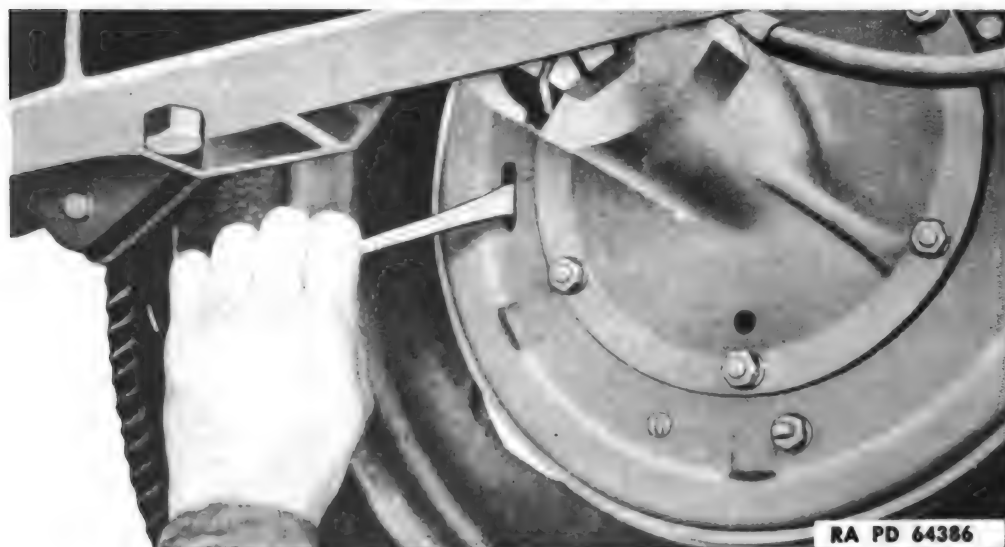


Figure 183—Turning Adjusting Screw

until a light drag is secured on feeler gage. Withdraw the gage and reinsert between lining and drum about $1\frac{1}{2}$ inches from the anchor end of the secondary shoe. If equal or slightly heavier drag is not found, adjust by loosening anchor pin nut and turning anchor pin in the direction necessary to secure proper clearance. Tighten the anchor pin nut securely and

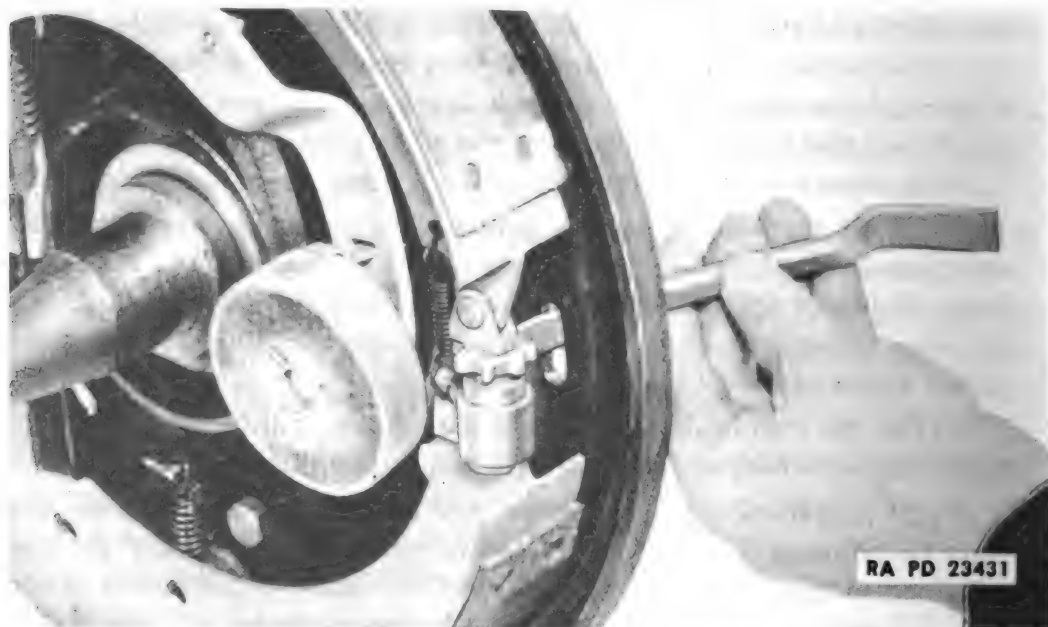


Figure 184—Method of Moving Adjusting Screw—Drum Removed

MAINTENANCE AND REPAIR INSTRUCTIONS



Figure 185—Using Feeler Gage

recheck clearance at secondary shoe eccentric. If the eccentric adjustment has to be changed, the anchor pin adjustment should again be checked and corrected if necessary.

NOTE: If the clearance at the anchor pin end of the secondary shoe is too great, turn the anchor pin in the direction the wheel turns in forward motion; if too little, turn anchor pin in opposite direction. While holding anchor pin with open-end or box wrench, tighten the anchor pin nut as tight as possible with a 12- to 16-inch wrench.

(7) After making anchor pin adjustment, adjust the primary shoe clearance as described in step (5) above. Be sure to install brake backing plate adjusting hole cover B198550 to prevent entry of foreign substance.

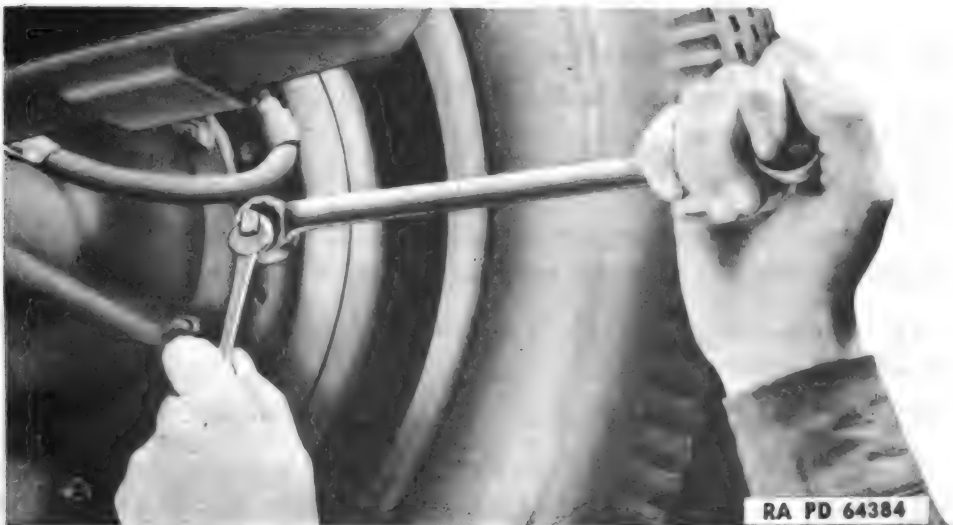


Figure 186—Adjusting Brake Anchor Pin

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL

NOTE: For satisfactory brake operation, replace brake shoes on all wheels when wear indicates that new lining is necessary.

52. HAND BRAKE LEVER ASSEMBLY.**a. Removal.**

(1) Remove sector retaining screws BCAX1ED, washers, and sector B160243.

(2) Loosen or remove clamp screw BABX1BE at bottom of lever after removing nut BBBX1B and washers.

(3) Tap out cam B198306 and remove hand brake lever C95723, using a $\frac{3}{4}$ -inch and a $\frac{1}{2}$ -inch wrenches.

(4) With a $\frac{3}{4}$ -inch wrench, remove retaining screws BCAX1EE and washers, and remove bracket B110677.

b. Disassembly.

(1) Remove the two cotter pins and both pins A24546 and remove lever B124428.

(2) Remove pawl cotter pin, eye A24543, rod B160239, washer, and spring A146959.

(3) Remove retaining nut BBAX1C, washer, and screw A147078, and remove spring A146959.

NOTE: A $\frac{9}{16}$ -inch wrench, a $\frac{3}{4}$ -inch wrench, and pliers (diagonals) are required for above operations.

c. Inspection. Inspect all parts for wear or damage and replace parts as necessary.

d. Assembly and Installation.

(1) Install mounting bracket B110677 on backing plate and secure with retaining screws.

(2) Install pawl B110678, retaining screw washer, and nut.

(3) Install washer and spring A146959 on rod B160239 and attach eye A24543. Then mount eye on pawl B110678 and install cotter pin.

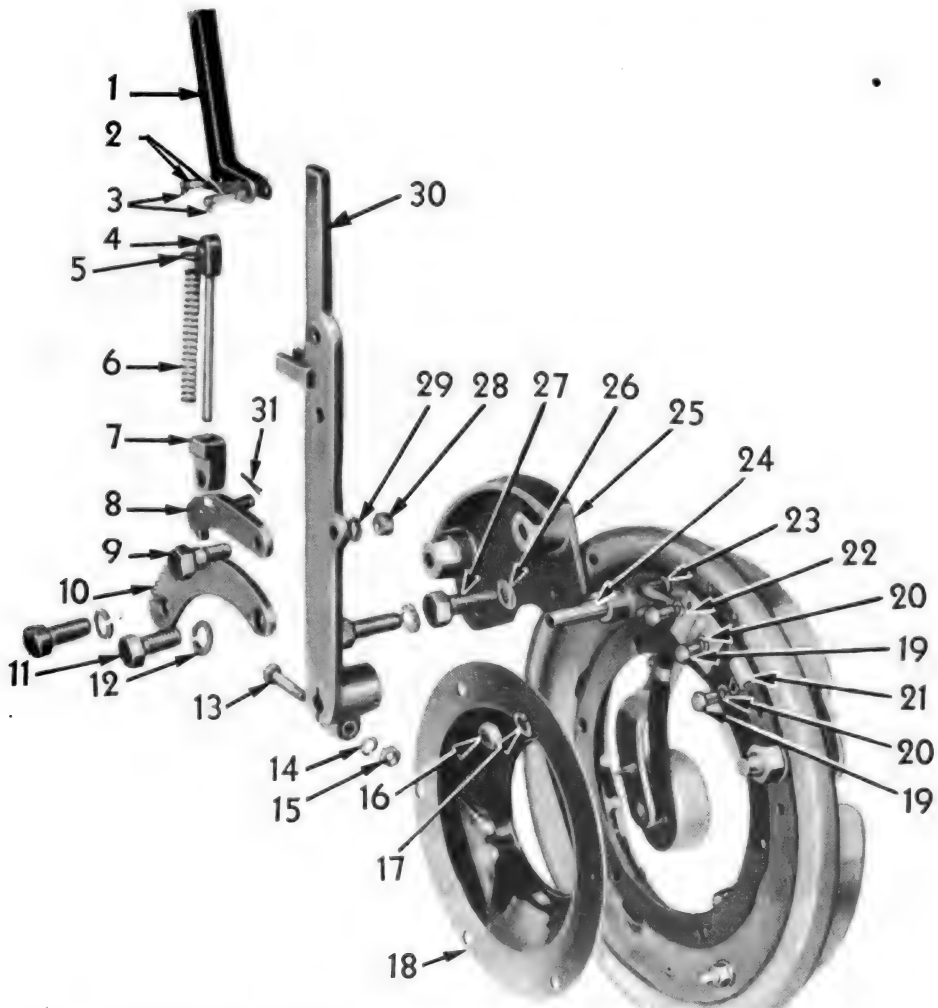
(4) Install lever B124428 at top of hand lever, install the two pins A24546 and cotter pins.

NOTE: A $\frac{9}{16}$ -inch wrench and a $\frac{3}{4}$ -inch wrench are required for above operations.

(5) Install cam B198306 and mount hand lever C95723 in position. Then install clamp screw, washer, and nut, but do not tighten nut.

(6) Install sector B160243, retaining screws, and washers.

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- 1 — LEVER - B124428
- 2 — PIN - A24546
- 3 — PIN - BFA11BB
- 4 — ROD - B229820
- 5 — WASHER - BEBX1G
- 6 — SPRING - A146959
- 7 — EYE - A24543
- 8 — PAWL - B110678B
- 9 — SCREW - A147078
- 10 — SECTOR - B160243
- 11 — SCREW - BCAX1ED
- 12 — WASHER - BECX1M
- 13 — BOLT - A287858
- 14 — WASHER - BECX1M
- 15 — NUT - BBBX1B
- 16 — NUT - BBBX1C

- 17 — WASHER - BECX1K
- 18 — BAFFLE - C95713
- 19 — SCREW - A228879
- 20 — WASHER - BECX1G
- 21 — CLAMP - A228849
- 22 — COVER - A228850
- 23 — GROMMETT - A228855
- 24 — CAM - B198306
- 25 — BRACKET - B110677
- 26 — WASHER - BECX1M
- 27 — SCREW - BCAX1EE
- 28 — NUT - BBAX1C
- 29 — WASHER - BECX1K
- 30 — LEVER - C95723B
- 31 — PIN - BFA11DF

RA PD 57770

Figure 187—Hand Brake, R. H.—Exploded View

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL



Figure 188—Positioning Brake Lever Cam

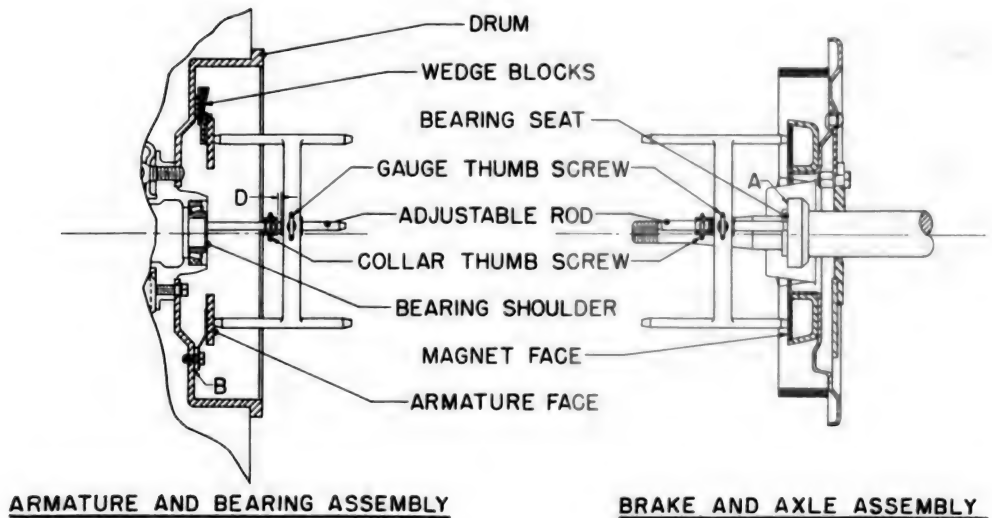
NOTE: A $\frac{1}{2}$ -inch wrench and a $\frac{3}{4}$ -inch wrench are required for above operations.

(7) Position the cam B198306, turning it if necessary, by pulling it out of the hand lever C95723, so it is approximately parallel with the pin and plate for the initial setting. The cam should also point away from the pin and plate assembly.

(8) Install brake shoes and check for clearance between cam and lever A228864 which is attached to the primary shoe assembly. When checking this clearance the hand brake pawl B110678 should be midway between the fully released position and the first notch in the sector B160243. There should be a small amount of clearance (approximately $\frac{1}{16}$ inch) between the cam B198306 and the lever A228864.

NOTE: If there is insufficient clearance, or excessive clearance between the cam B198306 and the shoe lever A228864, the primary brake shoe must be removed and the cam pulled out of the hand brake lever C95723 and turned as required. Tighten the clamp screw BABX1BE at

MAINTENANCE AND REPAIR INSTRUCTIONS



ARMATURE AND BEARING ASSEMBLY

BRAKE AND AXLE ASSEMBLY

RA PD 2996

Figure 189—Armature Gage for Disk Type Electric Brake

the lower end of the hand brake lever C95723 after the cam is properly located.

(9) Install brake shoe assemblies as instructed in paragraph 51 d. Adjust brakes if necessary as instructed in paragraph 51 d.

53. DISK TYPE ELECTRIC BRAKES.

a. Armature Spacing.

(1) The armatures should be depressed approximately $\frac{5}{32}$ inch against the magnet when the drum is mounted in running position. This measurement can be determined by a special armature gage before the drum is placed on the axle.

(2) Remove the disk and rim wheel from the wheel spindle. Remove the inner taper roller bearing from the wheel spindle and place it in its correct position in the hub.

(3) Place the short end of the gage against the magnet face (fig. 189).

(4) Slide adjustable rod against the bearing seat at A.

(5) Tighten gage thumbscrew.

(6) Slide collar against the spacer gage frame.

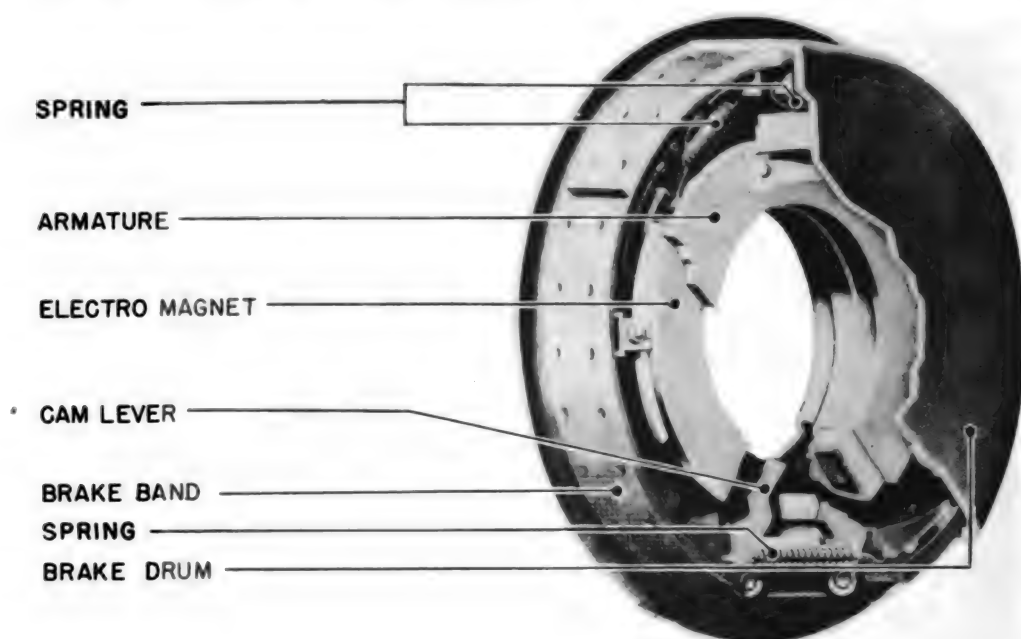
(7) Tighten collar thumbscrew.

(8) Loosen gage thumbscrew.

(9) At three places on the armature circumference, wedge the armature away from the brake drum to its full travel.

(10) Place the long legs of the gage against the face of the armature.

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RA PD 952

Figure 190—Disk Type Electric Brakes

(11) Slide the adjustable rod against the bearing shoulder.

(12) Tighten the gage thumbscrew.

(13) The distance D from collar to gage is the armature depression after assembly. If this is greater than $\frac{5}{32}$ inch, shim bearing out at bearing seat A. If it is under $\frac{1}{8}$ inch, then shim out armature at B.

(14) If instructions have been carefully followed, armatures will be depressed approximately $\frac{1}{8}$ inch against the magnet when the drum is mounted in running position.

CAUTION: When the spindle has a grease retainer that slips on the spindle back of the bearing, be sure the retainer is in place before checking the armature depression.

b. Assembly of Brake.

(1) In assembling, do not allow grease, however slight the amount, to touch any part of the brake. Grease will cause grabbing, locking, or loss of power.

(2) When the drum is placed in running position, the wheel nut must be pulled up snug to prevent loose bearings. The brake loses power if the armature is not kept firmly in contact with the magnet. When new brakes are installed, the vehicle should be given a small amount (about five miles) of road travel, using the brakes frequently until they work satisfactorily. When the brakes are wet, several applications while traveling are required to dry out the linings and facing.

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c. **Glazed Magnet Facing.** This condition is caused by weak electric current in the brake circuit, light brake applications, or grease or oil on the magnet facing. A magnet having a glazed or polished surface does not have sufficient friction to operate the brakes satisfactorily. To remedy cases of this kind, place the magnet in a lathe and turn about 0.005 inch to 0.008 inch off the magnet facing. The glazed surface may also be removed with a medium grade of CLOTH, abrasive, aluminum-oxide. *Do not remove metal from pole faces of magnet.* A new armature may be used with an old magnet, but a new magnet must not be used with an old armature.

d. **Loose Parts.** Worn bearings or loose wheels will cause erratic action of the brake and can be evidenced by the wide track the pole faces of the magnet make on the armature. Wheel hub may be cracked or broken and must be replaced.

54. ELECTRICAL SYSTEM.

a. **General.** The electrical system as covered in this manual applies only to the lighting and brake systems. Electric current for the lights and brakes is obtained from the prime mover. The brakes and lights are also controlled by suitable switches on the prime mover and the gun carriage. The dry-cell battery supplies electric current for application of the brakes should the drawbar and jumper cable become accidentally disconnected from the prime mover. In this case, the chain automatically operates the safety switch, closing the brake circuit and applying the brakes.

b. Replacement of Cables.

(1) Replacement of the entire wiring harness is seldom if ever required. However, replacement of individual cables may be necessary. To replace a cable, the old cable is removed and a new one installed. In this case, the cable ends are disconnected from the parts to which they are attached, the cable retaining clips removed, and the cable itself pulled out of position. The new cable is then installed, fastened in place with the retaining clips, and the necessary wire connections made.

(2) All wire connections must be properly made to prevent poor contact and high resistance. The contacting surfaces should be clean and all terminal screws firmly tightened. Wherever any two or more wires are connected with a splice, the splice should be soldered to insure a positive electrical connection. Wrap all soldered splices with friction tapes and paint with GLYPTAL, No. 1209.

(3) The cable clips are of the single wire and double wire type. Both types are retained in place either with screws and nuts or with screws only, requiring the use of a cross recess head screwdriver for removing and installing the screws, and a wrench for the nuts.

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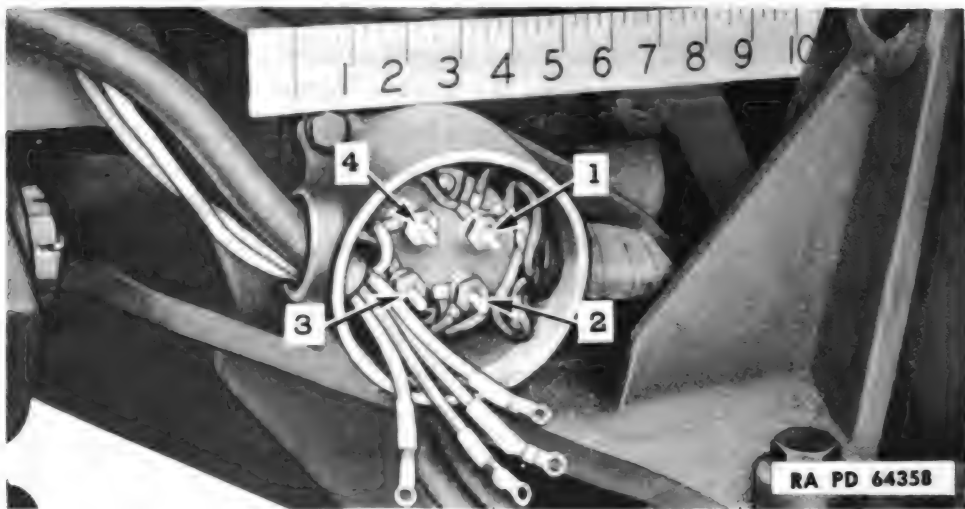


Figure 191—Disconnecting Jumper Cable from Junction Box

c. Jumper Cable.

(1) REMOVAL.

(a) Remove cover from junction box C53784 on left front of carriage and disconnect the four wires of the jumper cable EEB5040 from the terminals. Make certain that each wire is tagged or marked with tape in order to insure correct replacement.

(b) Remove tape and clip from chassis frame and pull jumper cable forward, removing it from the retaining tube on the drawbar.

(2) INSTALLATION.

(a) Install jumper cable in retaining tube on drawbar.



Figure 192—Disassembling Electrical Outlet Socket

MAINTENANCE AND REPAIR INSTRUCTIONS

RA PD 64424

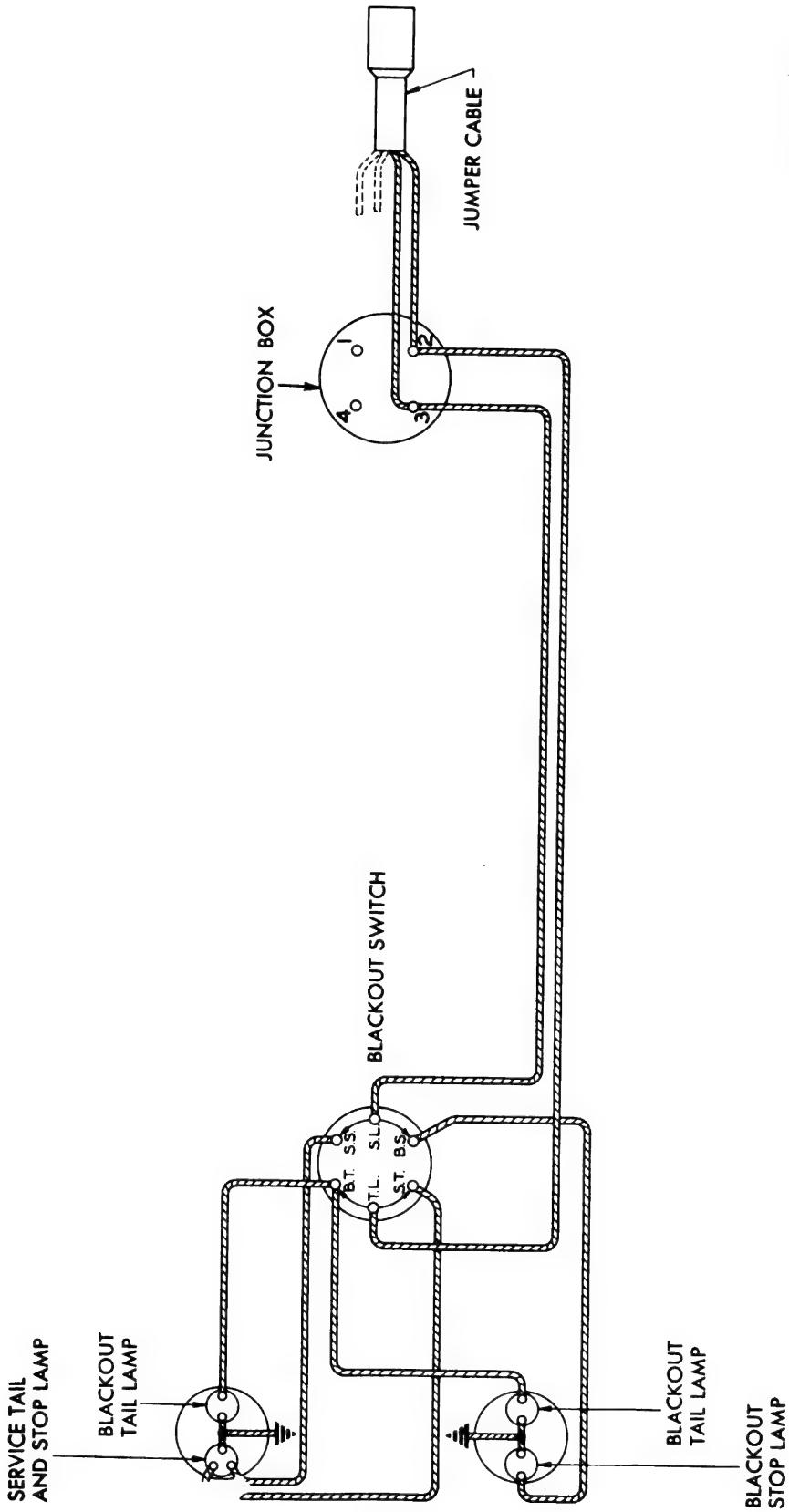


Figure 193—Wiring Diagram, Lighting Circuit

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL



RA PD 64387

Figure 194—Disconnecting Cables at Rear Lights

(b) Connect the four wires of the jumper cable to their respective terminals and install the junction box cover.

d. Electrical Outlet Socket.**(1) REMOVAL AND DISASSEMBLY.**

(a) Remove the four screws, lock washers, and nuts from outer face of socket assembly cover A148750 and remove the socket assembly.

(b) Remove the retaining screw at rear of assembly and lift off the rear cover.

(c) Remove the four cross recess head screws at side of socket assembly and withdraw the socket from its housing.

(d) Remove the four terminal screws, nuts, and contact plates.

(2) ASSEMBLY AND INSTALLATION.

(a) Install contact plates and the four rear terminal screws.

(b) Place the socket assembly in housing and install the four Phillips head screws.

(c) Install rear cover and secure with the retaining screw.

(d) Install front cover and secure with four screws, washers, and nuts.

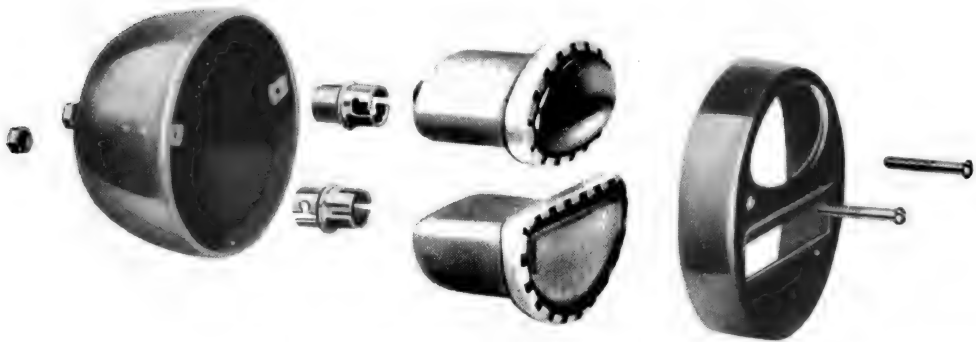
e. Rear Lights.**(1) REMOVAL AND DISASSEMBLY.**

(a) Remove the two nuts and washers from the front side of the rear frame member and pull lamp away from frame.

NOTE: The sealed beam lamp units of both rear lights may be removed and replaced without dismounting the light assembly.

(b) Pull tape on cables away from light sockets and disconnect cables

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RA PD 23450

Figure 195—Rear Lamp Assembly—Exploded View

from lights. Bayonet type connections are used. To release the cables, simply push in against spring tension, turn the cable end to the right, and pull the cable end out of the light socket. Remove lamp assembly.

(c) Remove the two cover retaining screws and dismount the cover. Then pull the sealed beam lamp assemblies out of the sockets.

NOTE: Further disassembly of the lamp assembly is seldom required and sockets should not be removed unless replacement is necessary.

(2) ASSEMBLY AND INSTALLATION.

(a) Install sealed beam lamp assemblies and replace the cover and secure with the two screws.

(b) Connect light cables to lamp assembly by pushing cable ends in against spring tension, turning them to the left and releasing them.

NOTE: The two conductor cables must be installed in the upper socket of the lamp assembly. Make certain that the two projections on cable end aline with the slots of the bayonet connection in the socket, for these slots are purposely offset to insure correct assembly.

(c) With lamp in position, insert the two long screws in the openings in rear frame member and install the washers and nuts.

(3) TESTING THE LIGHTS.

(a) Remove the cover from the rear of the electrical outlet socket and connect a six-volt storage battery in the lighting circuit by attaching one wire from the battery post to the terminal marked "TL" on back of electrical outlet socket. Connect the other battery lead to the terminal marked "GR," or ground it to some part of the carriage. Plug jumper cable in socket to complete the circuit.

(b) Turn the blackout light switch located on the front side of the rear frame member to the right of gun support, so that the slot in the end of the switch shaft lines up with the letter "S" on the switch. The service taillight (left light) should now light up.

(c) Turn the blackout switch so the slot in the end of the switch shaft

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Figure 196—Wiring Diagram, Brake Circuit

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lines up with the letters "BO" on the switch. A dim light should now be visible at the bottom of both taillights.

(d) Now remove the battery lead from the terminal marked "TL" and connect it to the terminal marked "SL." Turn the blackout light switch so the slot in the end of the shaft lines up with the letter "S" on the switch. The service stop light (left light) should now light up.

(e) Turn the blackout light switch so the slot in the end of the switch shaft lines up with the letters "BO" on the switch. A dim light should now be visible at the top of the right taillight.

f. Testing Brakes with Ammeter. An ammeter test should be made occasionally to determine if the brakes are drawing the correct amount of electrical current for proper operation. Too high a current draw indicates a short circuit somewhere in the brake wiring, while too little current indicates high resistance in the wiring system. This can result from a dirty or loose connection, wire partly severed, or dirty switch contacts.

(1) TEST ALL FOUR BRAKES TOGETHER.

(a) Remove the cover from the rear end of the electrical outlet socket and attach a wire from the ammeter to the terminal marked "BK." Attach a lead from a post of the six-volt storage battery to the other lead of the ammeter, and connect the remaining battery lead from the post of the battery to the terminal marked "GR" in back of socket.

(b) Plug the large end of the jumper cable in the electrical outlet socket to complete the circuit. With connections properly made, the current consumption for all four brakes should be approximately 7.5 amperes at room temperature (70 F).

NOTE: If ammeter indicates a discharge, reverse the ammeter or the battery connection.

(2) TEST EACH BRAKE SEPARATELY.

(a) Remove the cable clamp and connector cover from rear of brake backing plate assembly and pull one wire out of connector.

(b) Connect a six-volt battery in the circuit by connecting one battery wire to the "BK" terminal on back of electrical outlet socket and other battery wire to the "GR" terminal and plug in the jumper cable end.

(c) Attach one ammeter wire to connector from which the cable wire was removed. Then touch the other ammeter wire to the end of the exposed brake cable wire to complete the brake circuit for the particular wheel on which the test is being made. The current consumption for one wheel should be approximately 2.2 amperes at room temperature (70 F), and the ammeter reading should not vary more than 0.5 ampere at each wheel brake.

NOTE: If the ammeter indicates a discharge, reverse the ammeter or the battery connection.

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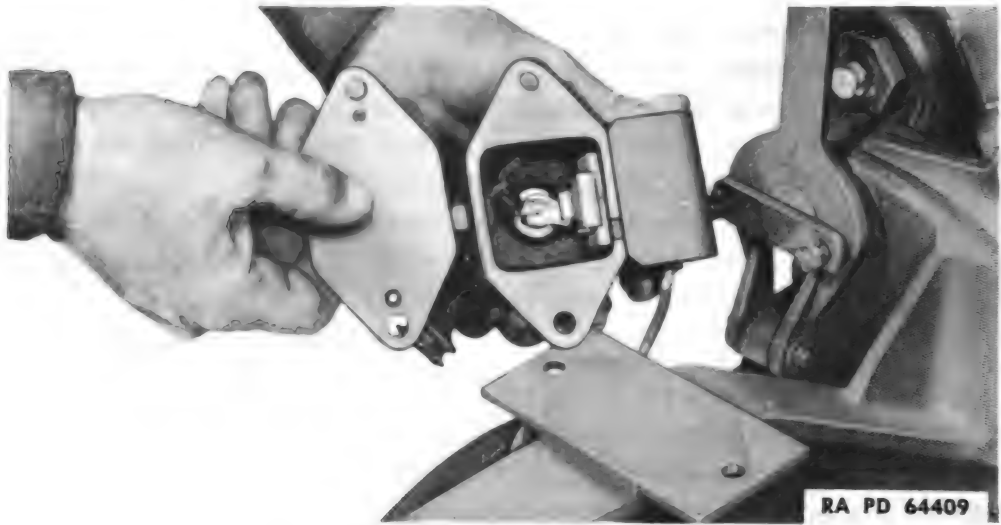


Figure 197—Removing Safety Switch

g. Safety (Breakaway) Switch.

(1) REMOVAL AND DISASSEMBLY.

- (a) Detach the chain EED5128A from the switch lever.
- (b) Take out the two screws mounting the switch assembly and remove the switch from the frame.

(c) Remove the top plate B173317 and disconnect cable ends from the switch terminals by removing the friction tape and taking off the retaining nuts and washers.

- (d) Remove bottom cover by taking out the two screws.

(2) INSTALLATION AND ASSEMBLY.

- (a) Install bottom cover and the retaining screws.
- (b) Attach the cable ends to switch terminals and install washers and retaining nuts. Wrap the terminals with friction tape and paint with GLYPTAL, No. 1209.

(c) Mount switch in position on bracket and install top plate, retaining screws, washers, and nuts.

55. STEERING MECHANISM.

a. Removal and Disassembly.

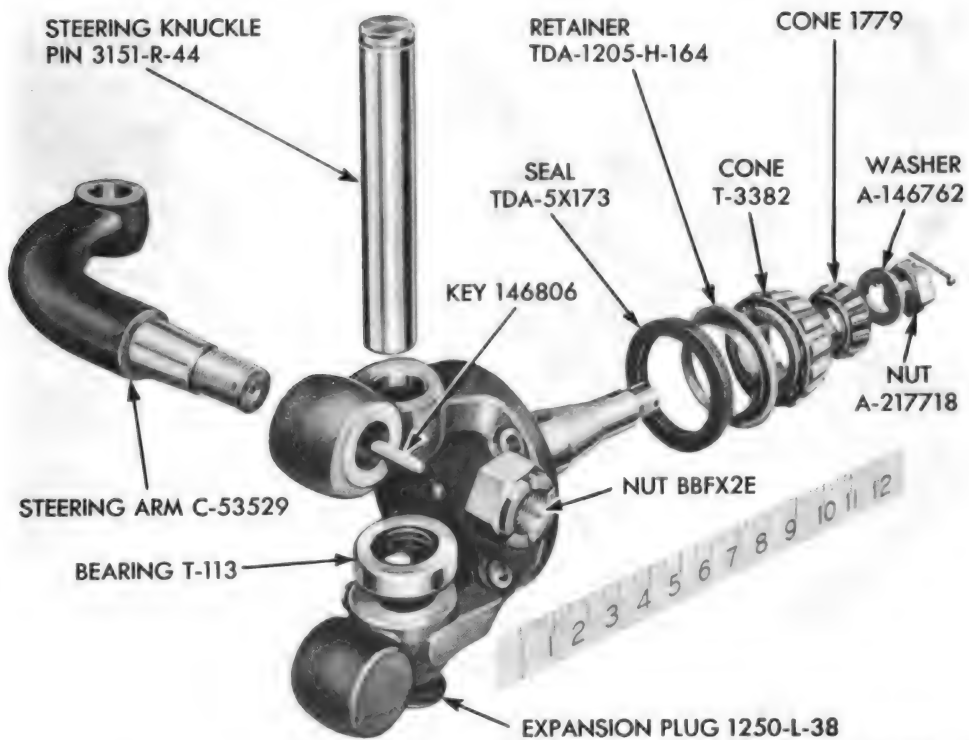
(1) Remove front wheel and drum assemblies as described in paragraph 50 a.

(2) Remove brake and backing plate assemblies. Do not disassemble brake.

(3) To remove steering knuckle assembly:

- (a) Remove cotter pin and castellated nut which secures the steering arm to the steering knuckle.

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RA PD 64373

Figure 198—Steering Knuckle Assembly—Exploded View

(b) Place a wood or brass drift against the threaded end and drift steering arm out of steering knuckle body.

(c) Pry retaining spring TDA1218-S-45 from groove in top of steering knuckle pin and remove retainer and felt seal.

(d) Drive out the wedge-shaped lock pin that locks the steering



RA PD 64371

Figure 199—Removing Retaining Spring

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RA PD 64372

Figure 200—Removing Steering Knuckle Pin Lock Pin

knuckle pin to front axle arm. Insert the steel drift from the rear or small end of pin.

(e) Remove the steel expansion plug and place a brass drift against the bottom of the steering knuckle pin and drive pin out the top of axle arm. Then remove steering knuckle and friction bearing located on under side of axle arm.



RA PD 64359

Figure 201—Removing Drawbar Assembly

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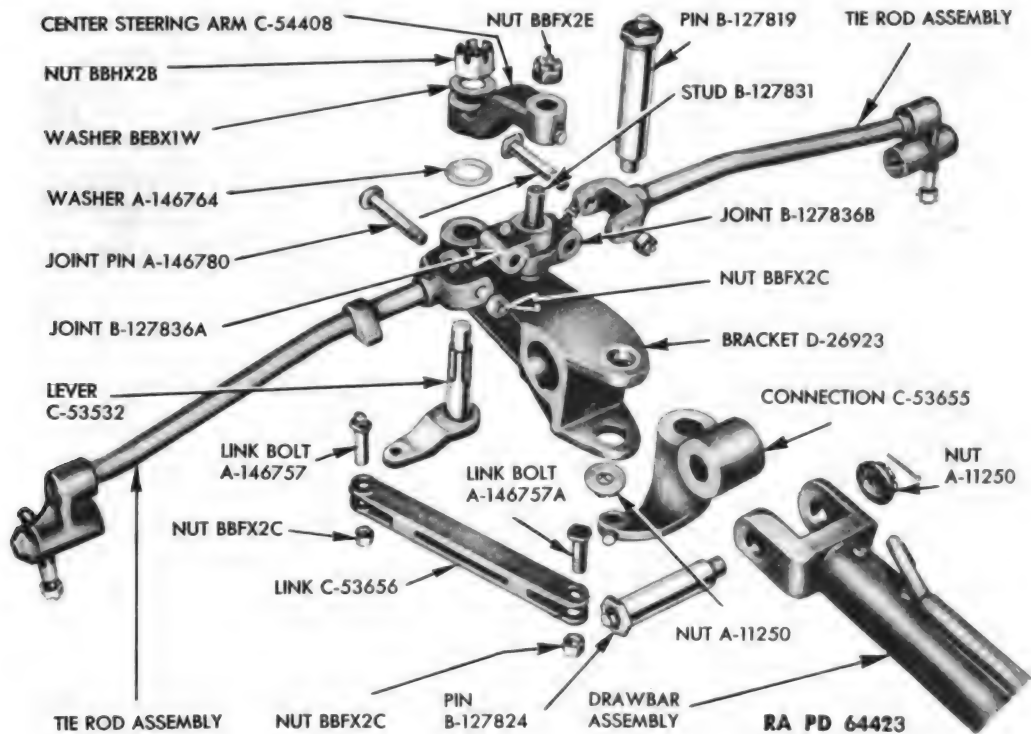


Figure 202—Steering Mechanism—Exploded View

(4) REMOVE DRAWBAR.

(a) Remove the cover from junction box C53784 on the left front of chassis frame and disconnect the four wires of the jumper cable from the terminals. Mark the wires with tape or other identification to insure proper reassembly.

(b) Disconnect drawbar chain assembly by removing cotter pin BFA1DK and nut BBFX2B from carriage end of each chain. Remove cap screws BCBX8BG.

(c) Remove cotter pin BFA1DT and nut A11250, and tap out drawbar pin B127824. Remove the drawbar assembly.

(5) REMOVE TIE ROD ASSEMBLIES.

(a) Remove cotter pins and castellated nuts A148433 from steering mechanism ball studs, and remove the steering arms.

(b) Disconnect the tie rods from steering rod joints, left B127836B and right B127836A, by removing cotter pins BFA1DK and nuts BBFX2C and withdrawing the two steering rod joint pins A146780. Lift off the tie rod assemblies.

(6) DISASSEMBLE TIE RODS.

(a) Remove the cotter pins BFA2AD from steering mechanism ball seat plugs A14679 and unscrew plugs.

(b) Remove the ball seat springs A41679 and ball seats A14677.

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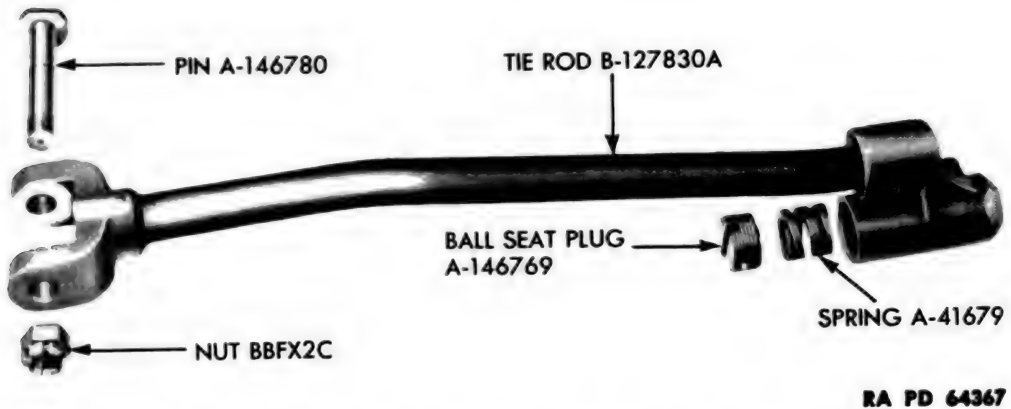


Figure 203—Tie Rod Assembly, Left—Exploded View

NOTE: The steering mechanism ball studs cannot be removed from sockets in tie rods, unless sockets are excessively worn. Should this condition exist, replace complete tie rod assembly.

(7) Remove steering mechanism link C53656 by removing cotter pins BFAX1DK and nuts BBFX2C. Remove steering mechanism link bolt, front A146757A and rear A146757, and lift off link.

(8) Remove cotter pin BFAX1DT and nut BBFX2E from front end of center steering arm C54408 and use a wood block against the threaded end to drive out steering rod joint stud. Lift off steering rod joints, right B127836A and left B127836B.



Figure 204—Removing Steering Mechanism Link Bolt—Rear

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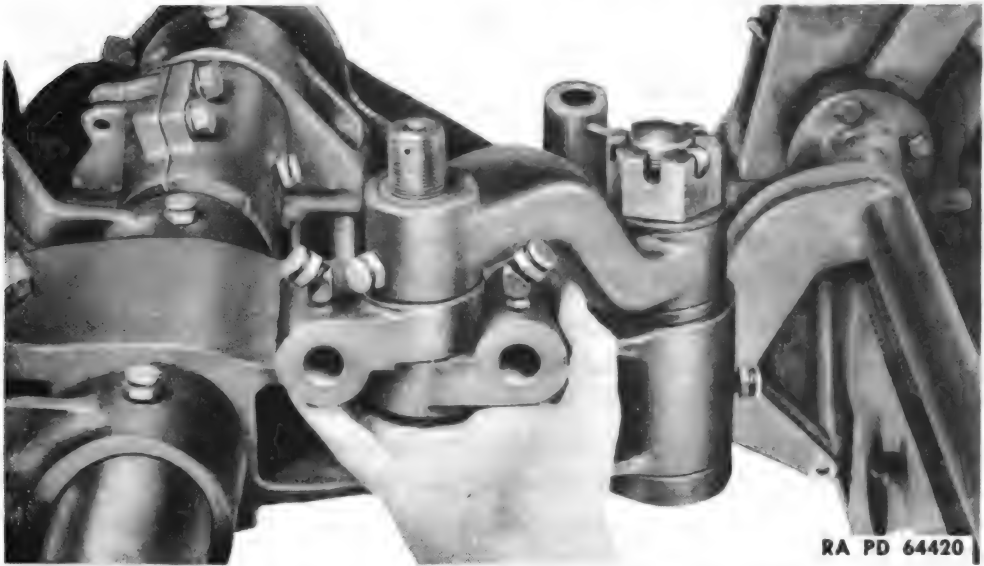


Figure 205—Removing Steering Rod Joints

(9) Remove center steering arm C54408 by removing cotter pin BFAX2DD, nut BBH2XB, and flat washer BEBX1W. Lift off arm and remove steering mechanism bearing washer A146764.

CAUTION: Mark end of steering lever shaft and top face of center steering arm with a file to insure correct assembly.

(10) Use a wood block against threaded end and drive steering lever C53532 from steering mechanism bracket.



Figure 206—Removing Center Steering Arm

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(11) Remove drawbar connection C53655 by removing cotter pin BFAX1DT and nut A11250, and use a wood block to drive drawbar connection pin B127819 from assembly.

b. Inspection.

(1) Clean all parts thoroughly and inspect for worn surfaces and bent parts. Replace all parts that are damaged beyond repair, excessively worn, or otherwise unfit for further service.

(2) Examine sockets of steering mechanism ball studs, and if worn sufficiently to permit the ball stud to be removed, replace the complete tie rod assembly.

(3) Center steering arm should fit freely over splines of steering lever. Remove any burrs that prevent proper assembly.

(4) Eliminate any looseness between steering rod joint pins, steering mechanism link pins, or steering mechanism ball studs and their connecting units; for a small amount of excessive play is multiplied many times by the time it reaches the wheels, and wheel "shimmy" may result.

(5) Examine the fit of the two keys securing the steering arms to steering knuckles. Replace badly worn keys and substitute oversize key stock if keyways in steering knuckles are worn.

c. Assembly and Installation.

(1) Install drawbar connection in steering mechanism bracket and secure with drawbar connection pin, installing nut A11250 and cotter pin BFAX1DT.

(2) Install steering lever C535324 in rear opening of steering mechanism bracket from bottom. Place steering mechanism bearing washer A146764 over lever and slide center steering arm C54408 on from above. Engage splines so that file marks on top of lever and steering arm align. Install washer BEBX1W and nut BBH2XB, and secure with cotter pin BFAX2DD.

(3) Place steering rod joints B127836B and B127836A on steering rod joint stud B127831 so that the right joint is on top and grease fittings are to the front, facing upward. Install stud in center steering arm and secure with nut BBFX2E and cotter pin BFAX1DT.

(4) Install steering mechanism link C53656 between arm of steering lever and arm of drawbar connection and insert the two steering mechanism link bolts. Install nuts BBFX2C and secure with cotter pins BFAX1DK.

(5) INSTALL STEERING KNUCKLE ASSEMBLY.

(a) Place steering knuckle over axle arm, raising it so the friction bearing may be inserted between lower side of axle arm and steering knuckle. Align the holes, and with a copper hammer, tap in steering

MAINTENANCE AND REPAIR INSTRUCTIONS

knuckle pin, making sure the flat recess for steering pin lock pin aligns with the hole in body of axle arm.

(b) Drive wedge-shaped lock pin into axle arm and place felt seat and retainer over top of pin. Secure with retaining spring TDA1218-S-45 by locking it securely in groove in pin. Install a new expansion plug in bottom of knuckle to retain grease.

(c) Insert the key in steering arm and install the arm in top of steering knuckle, securing castellated nut and cotter pin.

(6) **ASSEMBLE TIE RODS.** Install ball seat A14677 in each tie rod socket. Then install the spring A41679 and ball seat plug A14679. Tighten plug and lock in position with cotter pin BFAX2AD.

(a) Install the ball stud of each tie rod through steering arm and secure with nut A148433 and cotter pin. Place the yoke end in position over steering rod joint and insert a pin through each assembly. Secure with nut BBFX2C and cotter pins BFAX1DK.

(7) **INSTALL DRAWBAR.**

(a) Place rear end of drawbar in drawbar connection and install pin B127824, nut A11250, and cotter pin BFAX1DT.

(b) Connect drawbar chains by attaching shackles to front of chassis and installing cap screws BCBX8BG, nuts BBFX2B, and cotter pins BFAX1DK.

(c) Connect the four wires of the jumper cable to their proper terminals in junction box and replace cover.

56. FRONT AND REAR AXLE ASSEMBLIES.

a. General.

(1) The front axle assembly consists of two axle tubes, the left (inner), fitting into the right (outer), axle tube. Figures illustrating the following text show disassembly of axle with drawbar and tie rods removed from carriage. This operation was performed as carriage was disassembled, and is not necessary when disassembling front axle only. It is advisable, however, to remove drawbar for convenience.

(2) Rear axle assembly is removed and disassembled in the same manner as front axle. Rear wheels and brakes should be removed and counterpoise cylinders should be disconnected.

b. Removal and Disassembly.

(1) Jack up carriage and support both right and left sides of frame with blocks.

(2) Remove both front wheel and hub assemblies as described in paragraph 50 a.

(3) Remove steering knuckle pins and disconnect tie rods from steering knuckles. Remove brake and steering knuckle assemblies from axle arms as described in paragraph 55 a.

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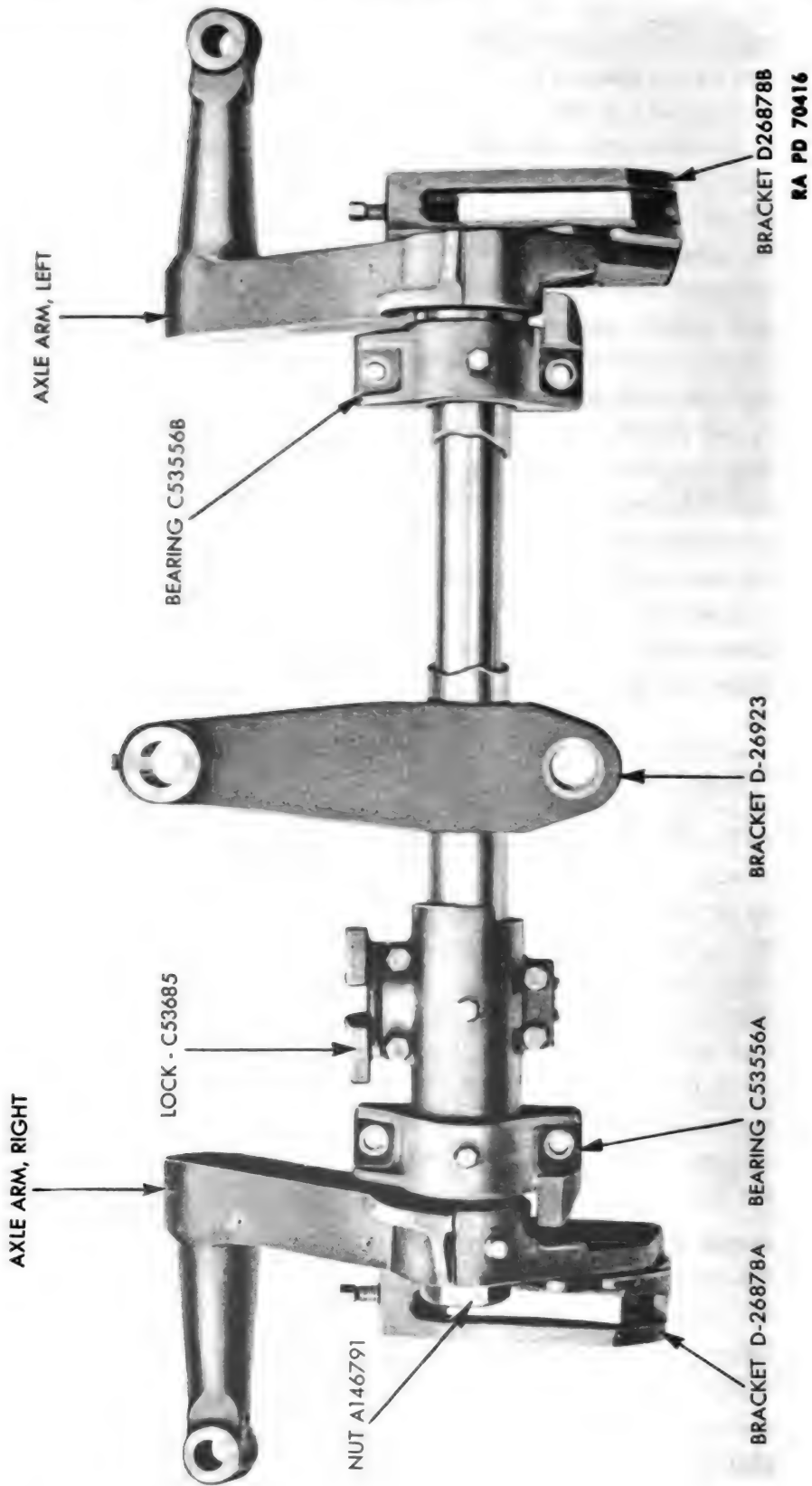


Figure 207—Front Axle Assembly—Exploded View

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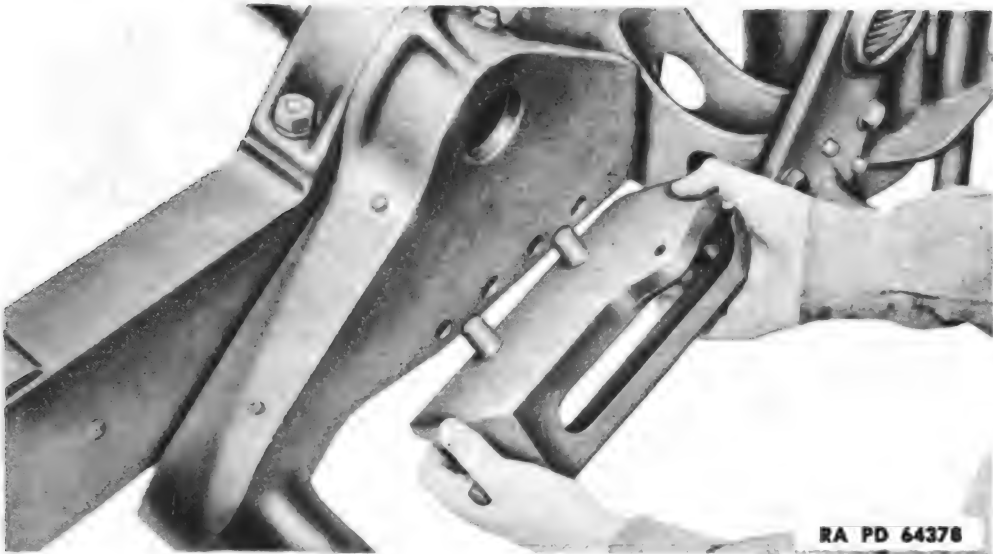


Figure 208—Removing Axle Bracket

(4) Disconnect both right and left counterpoise assemblies from axle brackets (left) 26878B and (right) 26878A, as described in paragraph 49 a.

(5) Remove axle brackets by removing cap screws, lock washers, and flat-head screws. Pry brackets from axle arms evenly and dowel pins will remove with bracket.

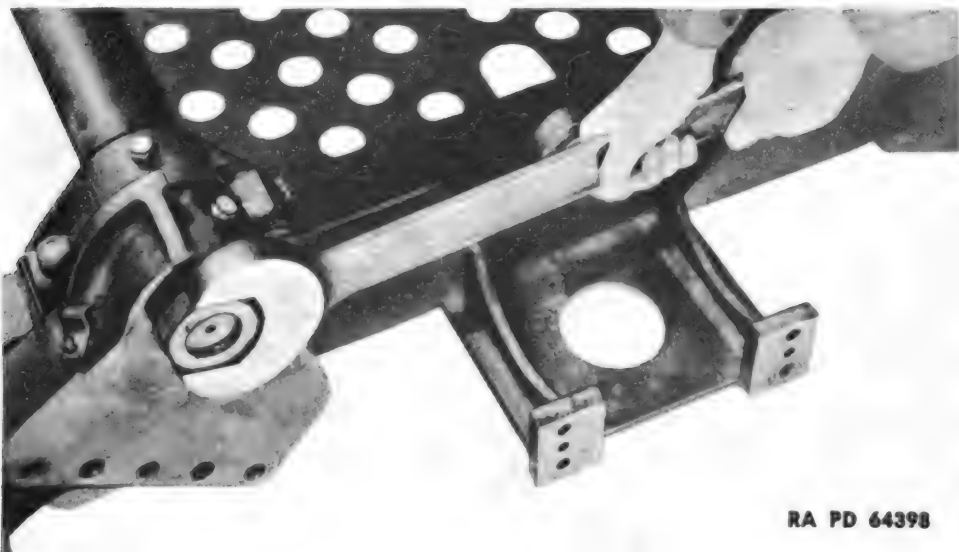


Figure 209—Removing Axle Nut—Rear

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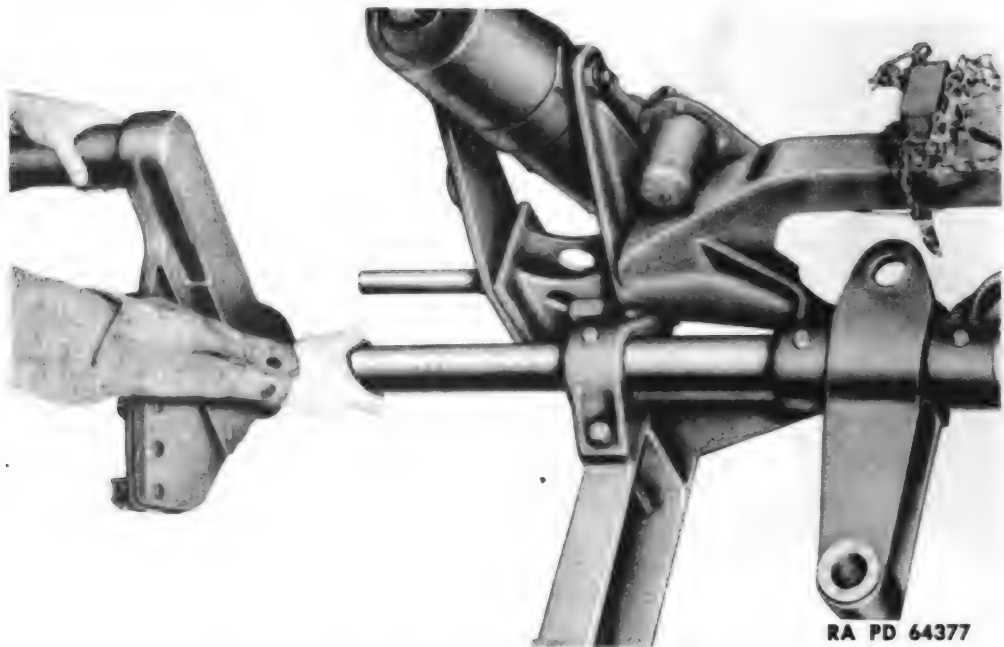


Figure 210—Removing Axle Tube—Inner

(6) Remove lock screw BCTX2C from axle nut A146791 and take off axle nut, using a $2\frac{5}{8}$ -inch wrench.

NOTE: Figure 209 shows counterpoise removed, for picture was taken during a complete disassembly of carriage. When removing axle as-

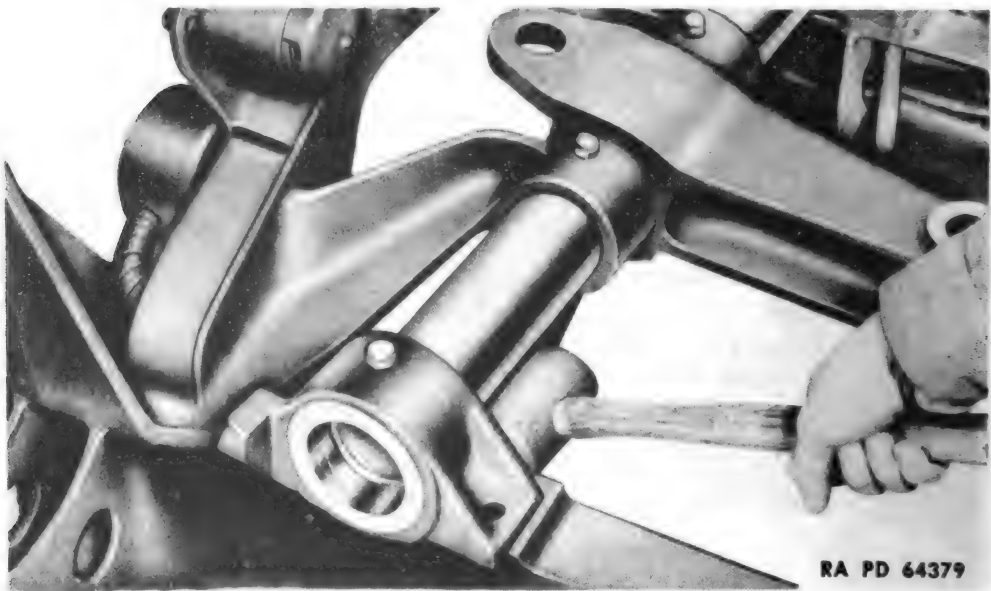
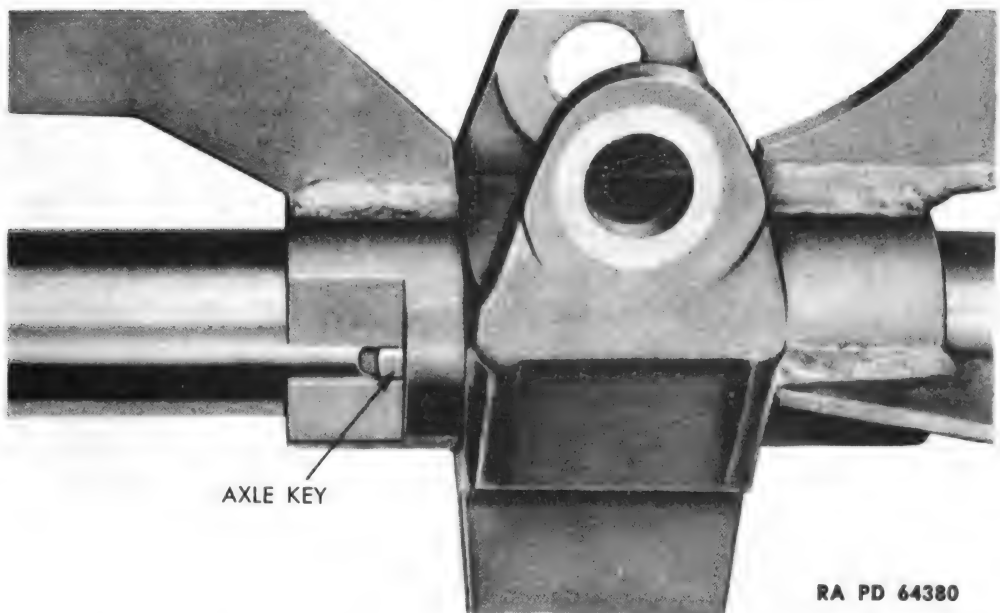


Figure 211—Removing Axle Bearing Assembly—Left

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Figure 212—Location of Key in Bottom of Outer Axle Tube

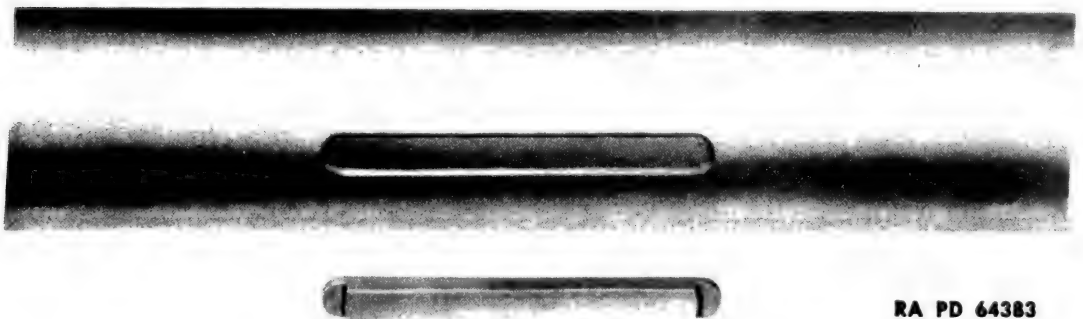
semblies, it is necessary only to disconnect the counterpoise rods from the axle brackets and swing cylinders out of way.

(7) Remove inner (left) axle tube by rotating and pulling out of assembly.

(8) Remove axle bearing assembly from left frame of lower carriage by removing two cap screws and nuts. Tap bearing off end of outer axle tube using copper hammer. Use a $\frac{7}{8}$ -inch wrench for heads of cap screws and a 1-inch wrench for nuts.

(9) Remove steering mechanism lock assembly C53685 by taking out four cap screws holding cap C53686 to lock, using a $\frac{3}{4}$ -inch wrench.

(10) Pull right (outer) axle tube straight out until front axle key A147276 is free of keyway in steering mechanism bracket D26923.



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Figure 213—Outer Axle Tube and Key

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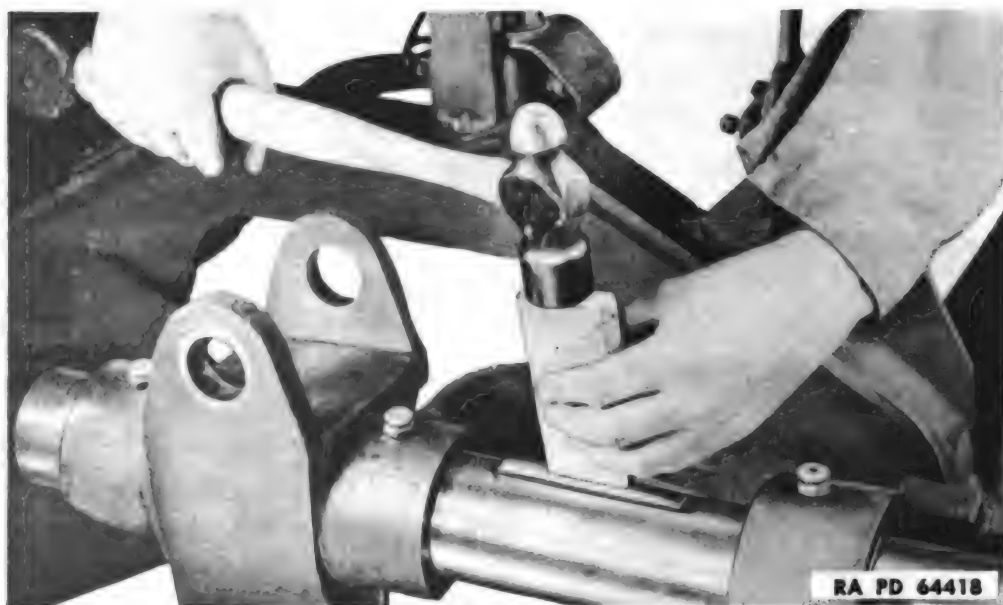


Figure 214—Installing Front Axle Key

(11) Disconnect right axle bearing assembly from frame of lower carriage by removing two bolts and nuts and withdraw outer axle assembly from steering mechanism bracket.

(12) Remove key A147276 from axle tube by inserting key in vise and raising axle. Remove axle bearing assembly.

NOTE: If painted portion of outer axle will not pass freely through axle bearing, remove the paint, rather than force the axle through the bearing.

c. Assembly and Installation. Before assembling front axle, make certain that all machined parts are free of rust and corrosion, clean all parts thoroughly, and polish machined surfaces with small amount of light oil, using CLOTH, crocus. Inspect bearings for smoothness and free operation.

(1) Remove rubber axle arm bumper B127892 on right side of carriage by straightening one end of bumper retainer pin.

(2) Install the left and right axle bearing assemblies, bolting them to carriage frame side members with two cap screws and nuts for each bearing. Tighten cap screws so that lock washers just start to compress. This will allow bearings to move slightly and allow alignment to the axle tubes.

(3) Lightly oil outer axle C53545B and start end of axle into bearing C53556B on right side of carriage, taking care to align axle with hole in bearing. Make certain bracket D26923 is in place between chassis

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supports; then move axle toward left side of carriage. Make sure keyway in tube is at top of axle and exposed.

(4) Insert key A147276 into keyway in tube. Then rotate axle so that key lines up with milled slot in chassis support.

(5) Aline bracket D26923 between chassis supports so that key now in axle will enter keyway in bracket D26923. Press axle into place so that end of axle tube passes into bearing C53556A.

NOTE: If chassis supports are misaligned it is sometimes difficult to enter end of axle tube into bearing C53556A. This can be overcome by installing tube with this bearing out of place, and then assembling bearing onto tube end and bolt to side member of carriage.

(6) Insert axle arm bumper B127893 onto carriage and secure in place with pin A147341, allowing axle arm to rest on bumper.

(7) Coat inner axle C53546B lightly with oil and slide into the outer axle tube, taking care that it is in good alinement while installing.

(8) Install axle nut A146791 using a $2\frac{5}{8}$ -inch wrench. Install lock screw BCTX2C.

(9) Install axle brackets and secure with cap screws, lock washers, and flat-head screws.

(10) Connect right and left counterpoise assemblies to axle brackets 26878B (left) and 26878A (right) as described in paragraph 49 h.

(11) Replace brake and steering knuckle assemblies and wheel and hub assemblies as units, securing with steering knuckle pins and connect tie rods to steering knuckles as described in paragraph 55 c.

(12) Place steering mechanism lock assembly C53685 on axle tube and install the four cap screws securing the steering mechanism cap C53686 to the lock.

(13) Remove supports and jack from under carriage and install drawbar and connecting pin.

57. CHASSIS.

NOTE: The chassis assembly consists of frame, welder cross members, gun support, outriggers, fenders, and front and rear platform plates.

a. Front and Rear Platform Plates.

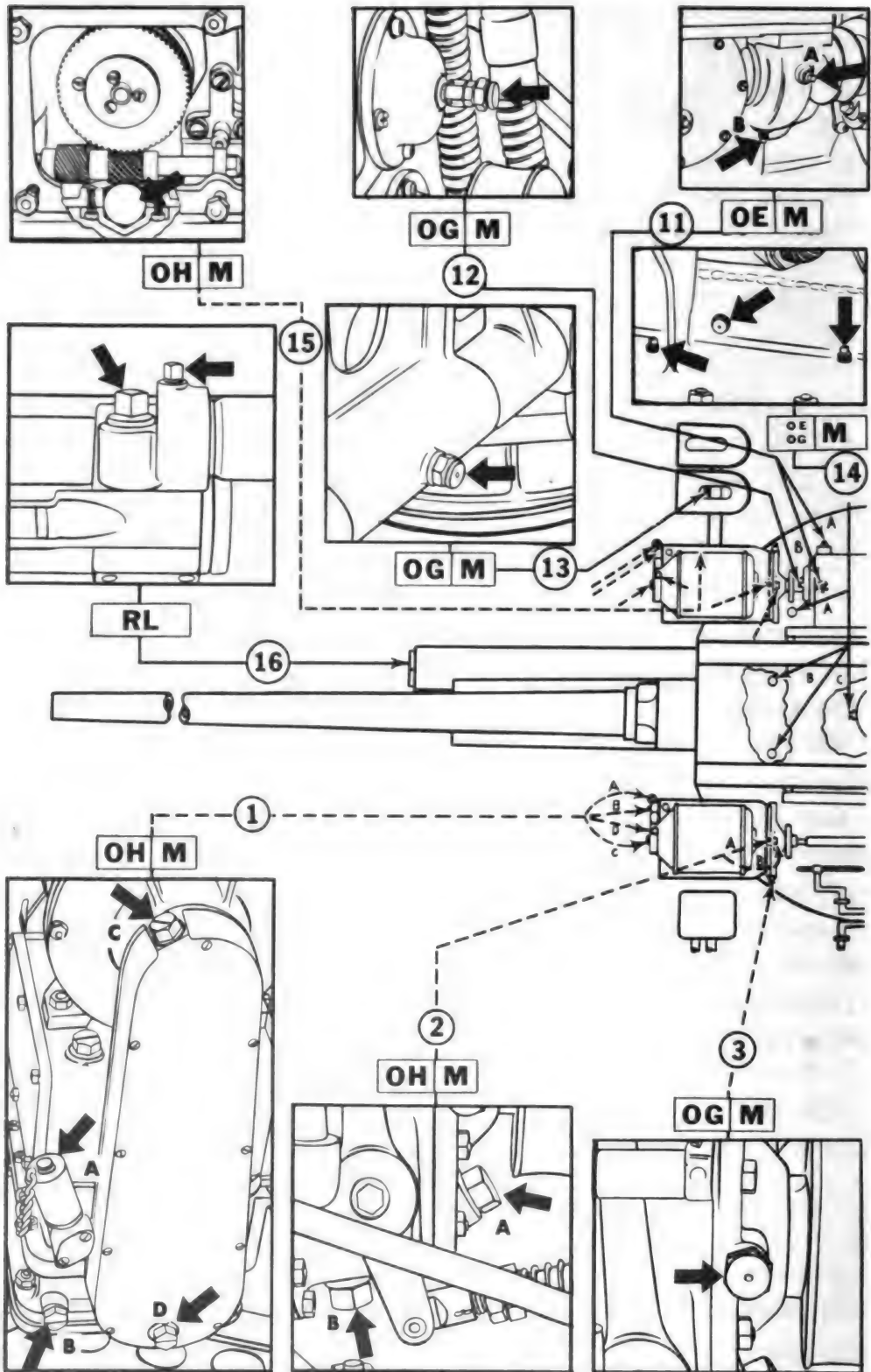
(1) **REMOVAL.** Take out 22 screws securing front plate and 15 screws holding rear plate.

(2) **INSTALLATION.**

(a) Check plates for damage, such as cracking, bending, or springing, and repair or replace as necessary.

(b) Install plates, securing with screws.

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Figure 215—Lubrication Guide for Top Carriage
(Balance of illustration on opposite page)

MAINTENANCE AND REPAIR INSTRUCTIONS

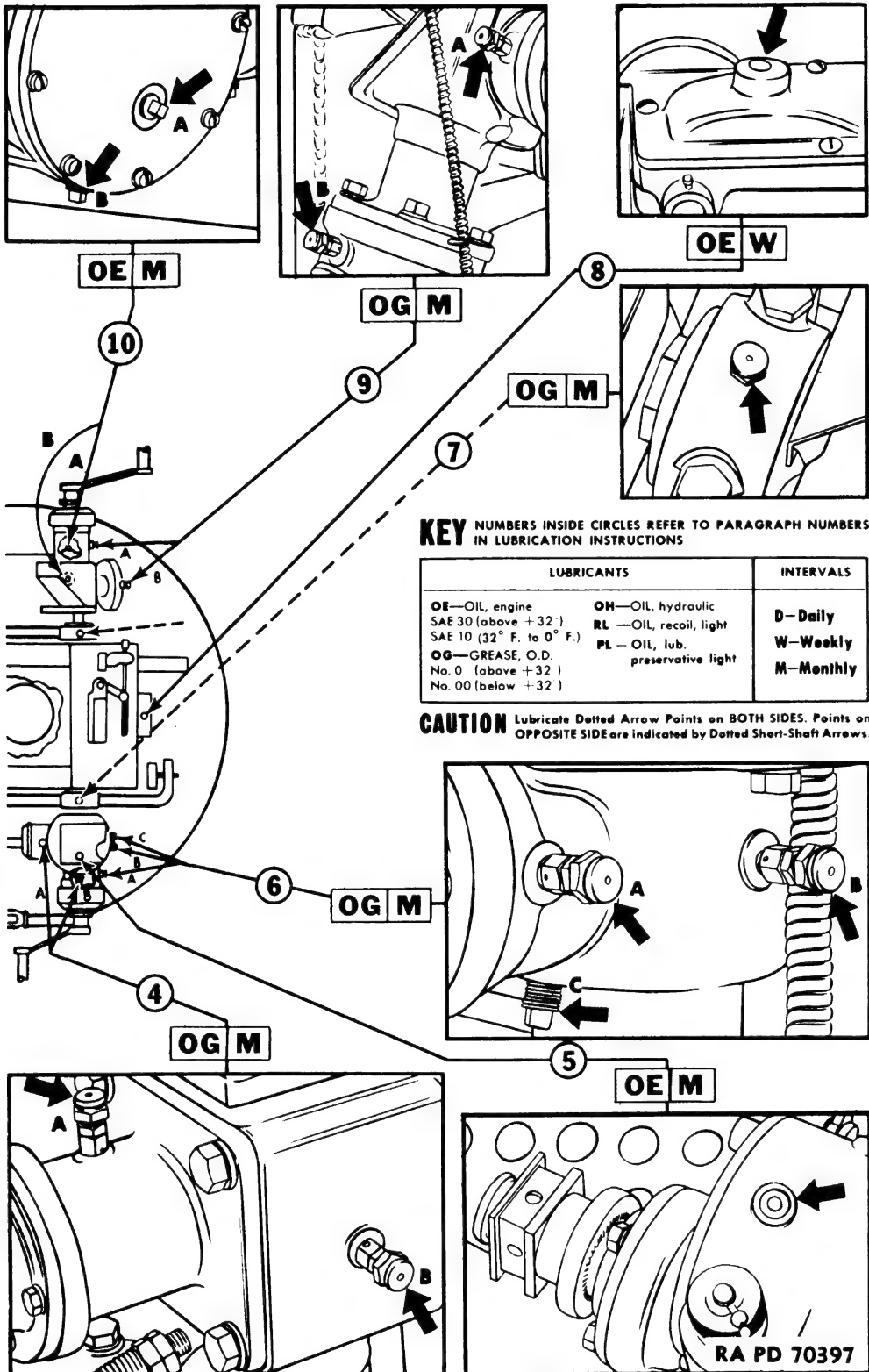


Figure 215—Lubrication Guide for Top Carriage

(Balance of illustration on opposite page)

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h. Gun Support D26836.

(1) REMOVAL.

(a) Disconnect bracket C53681 by removing two cap screws.

(b) Take out cotter pins from both ends of gun support pivot pin A146799.

(c) Drive pivot pin out of position and lift gun support off bracket D26895, disconnecting lever lock pin.

(d) Remove gun support lever C53675 by first taking out cotter pin and removing washer from lever pivot; then drive out taper pin and remove collar of lever locking pin. Lift lever off pivot and bracket.

(e) Remove bracket D26895 from chassis frame by removing two screws, nuts, and washers securing bracket to frame.

(2) INSTALLATION.

(a) Install bracket D26895 on chassis frame and secure with two screws, washers, and nuts.

(b) Install lever C53675 on pivot of bracket, install washer, and secure with cotter pin through lever pivot.

(c) Mount gun support D26836 in position on bracket and insert gun support pivot pin through holes in lower part of support uprights and bracket. Secure with cotter pin in each end of pin. Connect lever locking pin into gun support.

(d) Install bracket C53681, securing with two cap screws, nuts, and washers.

c. Fender Assembly.

(1) REMOVAL.

(a) Remove fender bracket C53579A or C53579B by removing four cap screws, nuts, and washers which secure bracket to chassis frame.

(b) Remove fender flap C53752 from fender bracket, removing four cap screws, nuts, and washers which secure flap to bracket with flap plate A146881.

(2) INSTALLATION.

(a) Mount fender flap on fender bracket, installing flap plate and securing assembly with four cap screws, washers, and nuts.

(b) Attach fender assembly to chassis frame by installing four cap screws which secure bracket to frame.

d. Outriggers.

(1) REMOVAL.

(a) Lower outrigger C53574 to firing position and remove cotter pins from each end of outrigger pivot pin A146866 and drive pin out of position, holding outrigger so it will not fall from bracket.

(b) Remove outrigger bracket D41728 by taking out five cap screws which secure bracket to frame. Chain clip A148769 and ring A6951 will be removed with bracket.

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(c) Remove outrigger turnbuckle from bracket by tapping out taper pin from lower turnbuckle screw pin A146865, then driving screw pin out of turnbuckle connection and lifting turnbuckle off bracket.

(2) INSTALLATION.

(a) Mount bracket D41728 on frame and secure with five cap screws, installing chain clip A148769 and ring A6951 when inserting screws.

(b) Install outrigger turnbuckle by first positioning connection in outrigger bracket and then inserting lower turnbuckle screw pin A146865 through connection and securing by tapping taper pin into center of screw pin connection.

(c) Mount outrigger on outrigger bracket, inserting outrigger pivot pin A146866 through bracket holes and opening in outrigger. Secure pivot pin in connection with cotter pin on each end of pivot pin.

58. LUBRICATION.

a. **General.** The following lubrication instructions for 37-mm Automatic Gun M1A2 and 37-mm Gun Carriage M3A1 are published for the information and guidance of all concerned, and supersede all previous instructions.

(1) **REFERENCES.** Materiel must be lubricated in accordance with the latest instructions contained in Technical Manuals and/or Ordnance Field Service Bulletins. Reference is made to the General Instructions section of OFSB 6-4 for additional lubrication information, and to the Product Guide section of OFSB 6-2 for latest approved lubricants.

b. **Lubrication Guide.** Lubrication instructions for all points to be serviced by the using arms are shown in the lubrication guide published herein, which specifies the types of lubricants required and the intervals at which they are to be applied. Guides from which data are reproduced are 10- by 15-inch laminated charts which are part of the accessory equipment of each piece of materiel.

c. **Points To Be Serviced and/or Lubricated by Ordnance Maintenance Personnel at Time of Ordnance Inspection.** Traversing and elevating gear cases, lower hand elevating gear case, hydraulic oil gears, traversing rack, top carriage support bearings, foot firing mechanism, and leveling mechanism screw (on left unit).

d. Reports and Records.

(1) **REPORTS.** If lubrication instructions are closely followed, proper lubricants used, and satisfactory results are not obtained, a report will be made to the ordnance officer responsible for the maintenance of the materiel.

(2) **RECORDS.** A complete record of lubrication servicing will be kept for the materiel.

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e. **Lubrication Instructions for Top Carriage** (fig. 216). Clean all fittings before applying lubricant. Where bearings can be seen, lubricate until new lubricant is forced from the bearing.

CAUTION: Lubricate after washing gun and carriage. Lubrication intervals indicated are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, rough roads, and dust, lubricate more frequently.

	Lubricant	Interval
(1) Hydraulic Oil Gears.	OH—OIL, hydraulic	M—Monthly
Point A—Filter Cover.		
Remove cap from filter and fill through center hole, using gun provided, until oil escapes from vent at side of filter.		
NOTE: If system is in frequent use, the oil should be changed every 6 months.		
Point B — Hydraulic Oil Gear Drain Plug.		
To change the oil, remove the drain plug. Be sure to replace it before filling.		
Point C — Oil Gear Chain Case Fill Plug.		
Point D — Oil Gear Chain Case Level Plug.		
Check level, monthly, and add lubricant at Point C.		
(2) Point A—Clutch Housing Fill and Level Plug.	OH—OIL, hydraulic	M—Monthly
Point B—Clutch Housing Drain Plug.		
(3) Hydraulic Oil Gear Shaft Bearing.	OG—GREASE, O.D.	M—Monthly
Lubricate sparingly.	No. 0 (above +32 F)	
	No. 00 (below +32 F)	
(4) Point A—Traversing Power Shaft Bearing.	OG—GREASE, O.D.	M—Monthly

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	Lubricant	Interval
Point B—Traversing Lower Gear Case. Lubricate sparingly.	No. 0 (above +32 F) No. 00 (below +32 F)	
(5) Azimuth Indicator. Lubricate sparingly.	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (32 F to 0 F)	M—Monthly
(6) Point A—Traversing Hand Crank Bearing. Lubricate sparingly. Point C—Traversing Upper Gear Case Drain Plug.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(7) Cradle Trunnion Bearing.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(8) Foot Firing Mechanism.	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (below +32 F)	W—Weekly
(9) Point A—Elevating Hand Crank Bearing. Point B—Lower Hand Elevating Gear Case. Lubricate sparingly.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(10) Point A—Elevating Worm Gear Case. Point B—Elevating Worm Gear Case Drain Plug. Check oil level monthly. If necessary, add lubricant to correct level. Every 6 months, drain and refill.	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (+32 F to 0 F)	M—Monthly
(11) Point A—Elevating Reduction Gear Case. Point B—Elevating Reduction Gear Case Drain Plug. Check oil level monthly. If necessary, add lubricant to correct level. Every 6 months, drain and refill.	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (+32 F to 0 F)	M—Monthly

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	Lubricant	Interval
(12) Elevating Worm Shaft Bearing. Lubricate sparingly.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(13) Foot Firing Pedal Shaft.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(14) Point A—Traversing Rack.	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (+32 F to 0 F)	M—Monthly
Point B—Top Carriage Support Bearings.	OE—OIL, engine OG—GREASE, O.D.	M—Monthly M—Monthly
Point C—Center Bearing.	No. 0 (above +32 F) No. 00 (below +32 F)	
(15) Helical Gear Lubricating Ball. Remove cover, retained by 6 studs, and fill recess around ball. CAUTION: Do not allow moisture, dirt, or grit to enter open mechanism.	OH—OIL, hydraulic	M—Monthly
(16) Recoil Mechanism. For instructions on quantity and application of recoil fluid, refer to War Department Recoil Fluid Guide No. 19 and OFSB 6-6.	R. L.—OIL, recoil, light	

NOTES

1. Traversing and elevating gear cases, hydraulic oil gears, traversing rack, top carriage support bearings, and foot firing mechanism are to be lubricated by ordnance maintenance personnel at the time of ordnance inspection.
2. Elevating Rack—Daily, clean and apply OIL, engine (seasonal grade). The teeth of the elevating rack and pinion require little lubrication; but, as a protection against rust, they will be covered with a thin coat of OIL, engine (seasonal grade). Dust and dirt will adhere to this oily film. Consequently, the teeth will be thoroughly cleaned and fresh oil applied before manipulating the elevating mechanism; otherwise, the grit will cause rapid wear of both rack and pinion. If considerable dust is present when gun is operated, the oil will be removed from the teeth and they will be allowed to remain dry until action is over.

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If the surfaces are dry, there is less wear than when coated with a lubricant contaminated with grit.

3. Breech and Firing Mechanism—Daily, and before and after firing, clean and oil all moving parts and exposed metal surfaces with OIL, engine (seasonal grade). CAUTION: To insure easy breech operation and to avoid misfiring in cold weather, clean with SOLVENT, dry-cleaning; dry and lubricate with OIL, lubricating, preservative, light. To clean firing mechanism, remove and operate pin in SOLVENT, dry-cleaning.
4. Gun Bore—Daily, and after firing, clean and coat with OIL, engine (seasonal grade).
5. Oilcan Points—Lubricate crank handles, clevises, and linkage with OIL, engine, weekly.
6. Cold Weather—For lubrication and service below 0 F, refer to OFSB 6-5.

f. Lubrication Instructions for Chassis. Clean all fittings before applying lubricant. Where bearings can be seen, lubricate until new lubricant is forced from the bearing.

CAUTION: Lubricate after washing gun and carriage. Lubrication intervals indicated are for normal service. For extreme conditions of speed, heat, water, sand, mud, snow, rough roads, and dust, lubricate more frequently.

	Lubricant	Interval
(1) and (10) Counterpoise Cylinder Trunnions (inner and outer—both sides—front and rear).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	2W—2 Weeks
NOTE: Monthly, remove dust cap on outer end of counterpoise cylinder and coat the surface above the piston with OG.		
(2) Front Axle and Bearing Assembly (3 lubrication fittings).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	W—Weekly
(3) Tie Rod (both sides).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	2W—2 Weeks
(4) Steering Knuckles (upper and lower fittings—both sides).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	2W—2 Weeks

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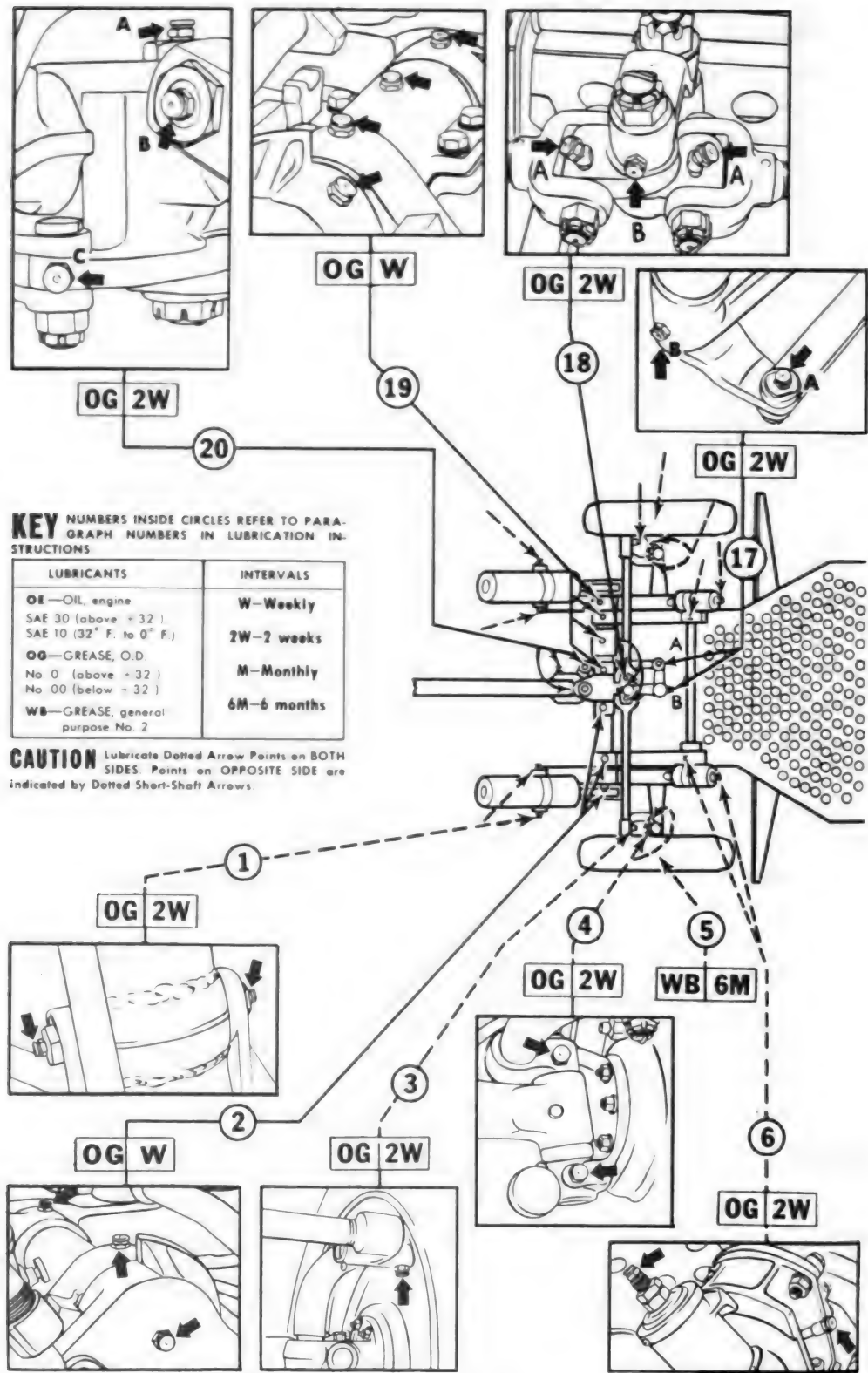
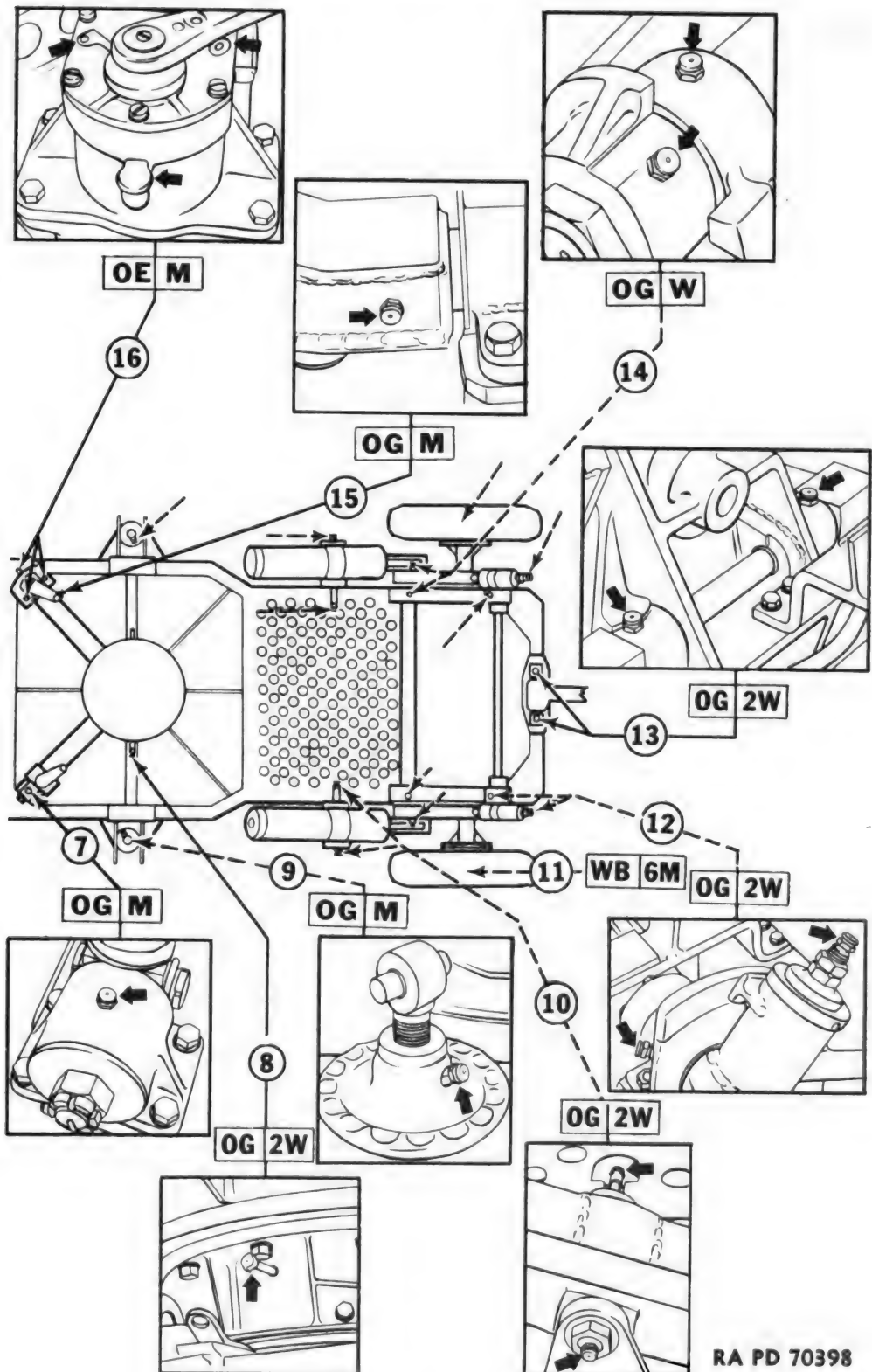


Figure 216—Lubrication Guide for Chassis
(Balance of illustration on opposite page)

MAINTENANCE AND REPAIR INSTRUCTIONS



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Figure 216—Lubrication Guide for Chassis
(Balance of illustration on opposite page)

ORDNANCE MAINTENANCE—37-MM ANTI-AIRCRAFT GUN MATERIEL

	Lubricant	Interval
(5) and (11) Wheel Bearings. Remove wheel; clean and repack bearings. To clean and pack wheel bearings properly, they must be removed from the hub. Follow the procedure below.	WB—GREASE, general purpose No. 2	6M—6 Months
1. Remove bearings from hub and wash in SOLVENT, dry-cleaning, until all the old lubricant is removed from both inside and outside of cage.		
2. Lay bearings aside to dry and wash inside of hub and spindle with SOLVENT, dry-cleaning.		
3. When bearings are thoroughly dry, pack races with GREASE, general purpose, No. 2, and re-assemble in hub. To pack a bearing satisfactorily, it is necessary to knead lubricant by hand or pack into space between the cage and inner race. Coat inside of hub and spindle with a thin coat of grease to prevent rusting.		
4. Mount wheel on spindle, and tighten on end of spindle until there is a slight drag when wheel is rotated.		
5. Back off nut until wheel turns freely without side play. Lock adjusting nut in position.		
6. Install hub cap. Lubricate bearings only.		

MAINTENANCE AND REPAIR INSTRUCTIONS

- | | Lubricant | Interval |
|---|-----------------------|------------|
| (6) and (12) Buffer Shaft Bearings and Buffer Cylinder (2 lubrication fittings on each side—front and rear). | OG—GREASE, O.D. | 2W—2 Weeks |
| | No. 0 (above + 32 F) | |
| | No. 00 (below + 32 F) | |
| <p>CAUTION: Since there is no vent in the outrigger turnbuckles, overfilling is likely to occur. Therefore, if the unit fails to function after lubrication, remove the fitting and operate the unit sufficiently to force out excess lubricant.</p> | | |
| (7) Leveling Mechanism (1 lubrication fitting). | OG—GREASE, O.D. | M—Monthly |
| | No. 0 (above + 32 F) | |
| | No. 00 (below + 32 F) | |
| (8) Top Carriage Leveling Bearing (1 lubrication fitting). | OG—GREASE, O.D. | 2W—2 Weeks |
| | No. 0 (above + 32 F) | |
| | No. 00 (below + 32 F) | |
| Fill until grease escapes from vent on opposite side. | | |
| (9) Outrigger Turnbuckle (both sides). | OG—GREASE, O.D. | M—Monthly |
| | No. 0 (above + 32 F) | |
| | No. 00 (below + 32 F) | |
| <p>CAUTION: Since there is no vent in the outrigger turnbuckles, overfilling is likely to occur. Therefore, if the unit fails to function after lubrication, remove the fitting and operate the unit sufficiently to force out excess lubricant.</p> | | |
| (13) Traveling Lock Bearings (2 fittings). | OG—GREASE, O.D. | 2W—2 Weeks |
| | No. 0 (above + 32 F) | |
| | No. 00 (below + 32 F) | |

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	Lubricant	Interval
(14) Rear Axle and Bearing Assembly (2 fittings on each side). NOTE: Outer fittings on left side are on end of axle.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	W—Weekly
(15) Leveling Bearings (1 fitting).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	M—Monthly
(16) Leveling Mechanism (2 dustproof oil fittings and oil cup).	OE—OIL, engine SAE 30 (above +32 F) SAE 10 (below +32 F)	M—Monthly
(17) Point A—Steering Link Pin. Point B—Steering Arm Pivot.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (+32 F to 0 F)	2W—2 Weeks
(18) Points A—Steering Rod Joints (right and left). Point B—Upper Steering Arm.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	2W—2 Weeks
(19) Front Axle and Bearing Assembly (3 fittings). Steering Mechanism Lock Assembly (1 fitting).	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	W—Weekly
(20) Point A—Drawbar Pivot Pin. Point B—Drawbar Hinge Pin. Point C—Steering Link Pin.	OG—GREASE, O.D. No. 0 (above +32 F) No. 00 (below +32 F)	2W—2 Weeks

NOTES

1. Leveling mechanism worm (on left unit) is to be lubricated by ordnance maintenance personnel at time of ordnance inspection.
2. Oilcan Points—Lubricate buffer adjustment linkage, buffer rod, counterpoise cam bracket, outrigger hinge pins, and hand levers with OE weekly.
3. Cold Weather—For lubrication and service below 0 F, refer to OFSB 6-5.

Section IV

CARE UNDER UNUSUAL CONDITIONS

	Paragraph
Lubrication	59
Moist or salty atmosphere	60
Sandy or dusty conditions	61

59. LUBRICATION.

a. Lubrication of the gun and carriage must be done as described in paragraph 58.

b. For extreme conditions of speed, heat, water, mud, snow, rough roads, etc., it is recommended that the materiel be lubricated more frequently.

c. For operation in areas where temperature is frequently below 0 F, refer to Ordnance Field Service Bulletin No. 6-5.

d. Only extended, and not temporary periods of climatic conditions warrant a change of lubricants. Ease of operation is the principal factor in determining when to change lubricants after a temperature drop.

60. MOIST OR SALTY ATMOSPHERE.

a. All exposed metal surfaces are to be coated with OIL, lubricating, preservative, medium.

b. If gun is not in active use, exposed metal surfaces are to be coated with COMPOUND, rust-preventive, light.

c. Check carriage frequently for cracked or chipped paint.

d. When gun is inactive, paulins should be secured in position on the carriage.

e. Paulins should be aired frequently and stored dry when not in use. NAPHTHALENE (flake) should be sprinkled on paulin and in the folds to prevent attack by insects.

f. It may be necessary to remove rust-preventives frequently when the gun is operated in seacoast areas and recoat metal surfaces. The salt air is very corrosive and lubricants tend to emulsify when exposed to salt air and water.

ORDNANCE MAINTENANCE—37-MM ANTIAIRCRAFT GUN MATERIEL**61. SANDY OR DUSTY CONDITIONS.**

a. When gun is operated in sandy or dusty areas, all lubricants on exposed working surfaces should be removed. Lubricants contaminated with dust or sand are more harmful than none, as the grease or oil will catch and hold dust or sand and act as an abrasive. Clean the gun thoroughly when action is over and relubricate.

SECTION V

INSTRUCTIONS FOR PACKING, SHIPMENT, AND STORAGE

	Paragraph
Preparation for storage or shipment.....	62
Care of guns in storage.....	63
Preparation for use after storage or shipment.....	64

62. PREPARATION FOR STORAGE OR SHIPMENT.

a. Clean the gun and carriage thoroughly, so that all oil, grease, and dirt are removed. Use SOLVENT, dry-cleaning, to remove oil and grease. Make certain no grease or oil is allowed to remain on tires, cables, or rubber connections.

b. Lubricate gun and carriage as instructed in paragraph 58, except that OIL, lubricating, preservative, medium, is to be used where lubrication guide calls for engine oil.

NOTE: All unpainted parts of the gun and carriage must be protected by a film of COMPOUND, rust-preventive, heavy. Painted surfaces must be touched up as necessary.

c. Remove and disassemble breechblock. Clean the bore of gun tube thoroughly. Clean the breech ring and breechblock. Coat tube and breech mechanism with COMPOUND, rust-preventive, light. Assemble and install breechblock.

d. Charge recoil mechanism with nitrogen and oil.

e. Gun may be stored in either firing or traveling position. However, tires and tubes should be removed, tubes inflated, and both tires and tubes wrapped in clean paper to exclude light and air. For detailed information on method of storing tires and tubes see OFSB 2-16 and TM 31-200.

f. Cover gun and carriage with paulins. Sprinkle paulins with NAPHTHALENE as a moth preventive.

g. If gun is to be stored for an extended period, remove dry-cell battery, as electrolyte may leak and corrode battery case.

63. CARE OF GUNS IN STORAGE.

a. Inspect stored guns frequently to check for rusting and deterioration.

b. Recoil mechanism should be exercised by releasing nitrogen, and pulling gun in and out of battery several times. Gun should be exercised once a month when stored.

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64. PREPARATION FOR USE AFTER STORAGE OR SHIPMENT.

- a. Replace tires and tubes.**
- b. Remove rust-preventive from coated surfaces with SOLVENT, dry-cleaning.**
- c. Remove and disassemble breechblock. Wash out all rust-preventive. Clean rust-preventive out of tube. Assemble and install breechblock.**
- d. Lubricate gun and carriage as described in paragraph 58.**
- e. Inspect gun and carriage, giving particular attention to all springs which may have taken a "set."**
- f. Brakes of stored carriages may not operate until the carriage has been towed and the brakes set several times.**

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65. STANDARD NOMENCLATURE LISTS.

a. Ammunition.

Ammunition for antiaircraft artillery	SNL P-5
Firing tables and trajectory charts	SNL F-69

b. Fire Control.

Director, A.A., M5 (for 37-mm and 40-mm A.A. gun carriages)	SNL F-209
Quadrant, gunner's, M1 (mils) (previously, M1919)	SNL F-140
Quadrant, gunner's, M1918 (mils)	SNL F-13
Set, control equipment, automatic gun, A.A., M1 (for cal. .50 A.A. machine gun)	SNL F-182
System, remove control, M1 (for 37-mm A.A. gun carriage M3A1)	SNL F-208
System, sighting, M2 (for 37-mm A.A. gun carriage M3)	SNL F-183
System, sighting, M6 (for 37-mm A.A. gun on multiple gun motor carriage M15)	SNL F-241
Unit, generating, M5 (for directors M5 and M5A1, and for seacoast uses)	SNL F-227

c. Gun, automatic, 37-mm, M1A2; and carriage, automatic gun, 37-mm, M3, M3A1, and M3E1	SNL A-29
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d. Maintenance.

Cleaning, preserving, and lubricating materials; recoil fluids, special oils, and miscellaneous related items	SNL K-1
Soldering, brazing and welding material, gases, and related items	SNL K-2
Tools, maintenance, for repair of automatic guns, automatic gun antiaircraft materiel, automatic and semiautomatic cannon, and mortars	SNL A-35
Truck, small arms, repair, M1	SNL G-72

Current Standard Nomenclature Lists are as tabulated here. An up-to-date list of SNL's is maintained as the "Ordnance Publications for Supply Index" . . . OPSI

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66. EXPLANATORY PUBLICATIONS.

a. Ammunition.

Ammunition, general	TM 9-1900
Shell, fixed, H.E., M54, etc.	FT 37AA-N-2
Shell, fixed, practice, M55A1, etc.	FT 37AA-N-2
Shot, fixed, A.P., M74, etc.	FT 37-S-1
Shot, fixed, A.P.C., M59, etc.	FT 37AA-N-2

b. Fire Control.

Antiaircraft artillery gunnery, fire control, position finding, and horizontal fire, antiaircraft automatic weapons (case I firing)	FM 4-112
Auxiliary fire-control instruments (field glasses, eyeglasses, telescopes, and watches)	TM 9-575
Generating unit M5	Instruction book in pocket inside instrument panel door of generating unit.
37-mm antiaircraft gun (case I firing)	FM 4-140

c. Maintenance.

Chemical decontamination materials and equipment	TM 3-220
Cleaning, preserving, lubricating, and welding materials and similar items issued by the Ordnance Department	TM 9-850
Decontamination, 1941	TC 38
Defense against chemical attack	FM 21-40
Field inspection of ordnance materiel by service command inspectors in continental United States	TB 1100-1
Maintenance and care of pneumatic tires and rubber treads	TM 31-200
Military chemistry and chemical agents	TM 3-215

d. Miscellaneous.

Ordnance field service in time of peace	AR 45-30
Range regulations for firing ammunition for training and target practice	AR 750-10

e. Storage and Shipment.

General supply: storage and shipment of rubber tires, tubes, and camelback	OFSB 2-16
Instructions and specifications for packaging ordnance general supplies	IOSSC-(a)
Instructions for marking shipments of ordnance general supplies	IOSSC-(b)
Ordnance storage and shipment chart—Group A—major items	OSSC A

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(For explanation of symbols, see FM 21-6)

